

July 2010

TACTICAL AIRCRAFT

DOD's Ability to Meet Future Requirements Is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions



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Highlights of GAO-10-789, a report to the Committee on Armed Services, House of Representatives

Why GAO Did This Study

From 2011 through 2015, DOD plans to spend over \$336 billion to operate, maintain, modernize, and recapitalize its tactical air forces. Since DOD projects tactical aircraft inventory shortfalls over the next 15 years, it must effectively balance resources between an increasingly expensive Joint Strike Fighter program and the need to keep its legacy aircraft viable.

GAO was asked to assess DOD's tactical aircraft requirements, the extent to which plans for upgrading and retiring legacy aircraft and acquiring new aircraft are likely to meet the requirements, and how changes in strategic plans and threat assessments have affected requirements. GAO analyzed tactical aircraft requirement and inventory data, key plans and threat assessments.

What GAO Recommends

GAO suggests that Congress consider requiring that costs associated with modernizing and sustaining the legacy fleet be included in future investment plans, and recommends that DOD 1) better define requirements and the size and severity of projected shortfalls, 2) clearly articulate how systems like unmanned aircraft are accounted for, and 3) complete a comprehensive cost and benefit analysis of options for addressing expected shortfalls. DOD agreed with the second recommendation and partially agreed with the others, citing current and planned actions. GAO believes its recommendations remain valid.

[View GAO-10-789 or key components.](#)
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TAUTICAL AIRCRAFT

DOD's Ability to Meet Future Requirements Is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions

What GAO Found

DOD's current combined tactical aircraft requirement is around 3,240 aircraft. The requirement includes a mix of various types of Air Force, Navy, and Marine Corps fixed-wing fighter and attack aircraft. The Air Force requirement is 2,000 aircraft, and the combined Navy and Marine Corps requirement is about 1,240 aircraft. To achieve national security objectives, however, DOD not only needs the right quantity of aircraft to adequately equip each service's force structure, but must also have the right organization and mix of aircraft capabilities. The services have reduced required quantities by a combined total of around 900 aircraft since 2002. Service officials believe that the current numbers provide sufficient capabilities to carry out assigned missions with manageable risk, but are not at optimal levels. Although officials also stated that current requirements account for capabilities provided by other weapon systems, such as unmanned aircraft and bombers, it is unclear exactly how and to what extent.

DOD expects to encounter shortfalls in both Air Force and Navy tactical aircraft inventories, but the timing and magnitude of these shortfalls largely depend on assumptions about Joint Strike Fighter (JSF) acquisitions and the viability of legacy aircraft. The JSF program has continued to experience cost and schedule problems and is in the process of being restructured. In addition, DOD's investments in legacy systems have generally been assigned lower priority in the budgeting process. As a result, many legacy aircraft systems are becoming increasingly difficult to maintain as parts needed to support key subsystems age and become obsolete. The Navy and Air Force are exploring various options for closing their projected inventory shortfalls—including upgrading and extending the service lives of hundreds of legacy aircraft, and making modifications to how tactical air forces are used. Many of these options may be funded in future budgets and could cost billions of dollars.

The services have not fully reconsidered tactical aircraft requirements in light of recent changes in strategic planning and threat assessments, but according to service officials, the 2010 Quadrennial Defense Review (QDR) affirmed the existing force structure in the near-term, principally the next 5 years. Similarly, DOD's recent Aircraft Investment Plan, which was required by Congress, and fiscal year 2011 budget decisions did not directly affect tactical aircraft requirements, but did make some changes in near-term aircraft investments. The QDR reflected a change in how DOD views future national security challenges, examined expected challenges in various combinations, and recognized the need to plan for and acquire adaptive and agile systems, including unmanned aircraft. The department is still in the process of establishing the analytical foundation for its future requirements. Until requirements analyses and JSF restructuring are complete and capabilities provided by unmanned aircraft and bombers are more clearly accounted for, it will be difficult for DOD to make informed investments in legacy aircraft upgrades and modernizations, and new aircraft procurements. In addition, without a joint comprehensive analysis that compares and contrasts the costs and benefits of various Air Force and Navy options for addressing inventory shortfalls, it will be difficult to determine the best approach to meeting requirements and mitigating shortfalls or eliminating redundancies.

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**United States Government Accountability Office
Washington, DC 20548**

July 29, 2010

The Honorable Ike Skelton
Chairman
The Honorable Howard P. "Buck" McKeon
Ranking Member
Committee on Armed Services
House of Representatives

The Department of Defense (DOD) expects to invest over \$336 billion to operate, maintain, modernize, and recapitalize its tactical air forces during fiscal years 2011 through 2015. Tactical aircraft—fixed-wing fighter and attack planes—provide air-to-air, air-to-ground, and electronic warfare capabilities that are vital to the success of combat operations and homeland defense. Most of the department's current tactical aircraft were purchased in the 1970s and 1980s and are reaching the end of their expected service lives. The Air Force and Navy project that DOD's tactical aircraft inventories will soon drop below required levels and shortfalls will persist for years. These projected shortfalls present a formidable challenge as DOD must effectively balance scarce resources between the increasingly more expensive Joint Strike Fighter (JSF) program and the need to invest in keeping its legacy aircraft viable for longer periods of time than originally expected.

Despite DOD's long-standing plan to recapitalize its aging tactical aircraft fleet, we found in 2007 that the department did not have a comprehensive, integrated investment strategy for identifying joint priorities, critical capability gaps, and allocating scarce resources.¹ Since the issuance of that 2007 report, several new developments and a changing threat environment have again raised questions about requirements and the direction of DOD's plans for recapitalizing its fleet of tactical aircraft. As a result, the House Armed Services Committee asked GAO to (1) identify DOD's current tactical aircraft requirements, (2) determine the extent to which DOD's plans for upgrading and retiring legacy aircraft and for acquiring new aircraft are likely to meet its current requirements, and (3) assess how changes in DOD's strategic planning and threat assessments, as reported in its 2010 Quadrennial Defense Review (QDR), and recent investment

¹ GAO, *Tactical Aircraft: DOD Needs a Joint and Integrated Investment Strategy*, GAO-07-415 (Washington, D.C.: Apr. 2, 2007).

decisions have impacted tactical aircraft requirements. The committee also requested an update on the cost and schedule status of DOD's tactical aircraft programs.

To conduct our work, we drew extensively on other GAO work related to tactical aircraft requirements and force planning and reviewed the analyses and assessments of other government agencies and non-governmental organizations. We reviewed documents on Air Force, Navy, and Marine Corps tactical aircraft requirements and met with knowledgeable officials from the Office of the Secretary of Defense (OSD) and the military services to discuss the processes and data used to determine the requirements. We discussed the extent to which unmanned aircraft, bombers, and other systems providing similar warfighting capabilities were factored into the requirements. We collected tactical aircraft inventory projections from the military services and compared that data with the requirements to determine the extent to which DOD's projected force structure would meet the established requirements. We identified and analyzed various factors impacting future inventory levels and assessed several inventory management and acquisition options, some of which the services are considering. We reviewed the National Defense Strategy, National Military Strategy, the 2010 QDR, previous QDR reports, OSD's recent Aircraft Investment Plan Fiscal Years 2011–2040, and other strategic planning and threat assessment documents to identify recent changes in defense threat assessments and planning factors. We met with OSD and service officials to discuss how those changes have impacted or could impact tactical aircraft requirements. We also assessed the cost, schedule, and performance status of selected legacy and new tactical aircraft programs, and met with program officials in each program office. Appendix I contains more details on our engagement's scope and methodology.

We conducted this performance audit from September 2009 to July 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Tactical air forces are critical to achieving and maintaining air dominance during combat operations. These forces include Air Force, Navy, and Marine Corps fixed-wing fighter and attack aircraft with air-to-air, air-to-

ground, and electronic warfare missions, along with related equipment and support activities. These aircraft operate during the first days of a conflict to penetrate enemy air space, defeat air defenses, and achieve air dominance, allowing follow-on ground, air, and naval forces freedom to operate within the battle space. Once air dominance is established, tactical aircraft continue to strike ground targets for the remainder of the conflict. Some tactical aircraft are also essential to protecting the homeland by responding to potential airborne and ground based threats. DOD plans to spend about \$67 billion annually, on average, over the next 5 years to operate, maintain, modernize, and recapitalize its tactical air forces (see app. II).

DOD's current tactical aircraft fleet is comprised of both legacy and new aircraft. The legacy forces include Air Force F-16, F-15, and A-10 systems and Navy and Marine Corps F/A-18A-D, EA-6B, and AV-8B aircraft. Most of these aircraft were purchased in the 1970's and 1980's and are more than 20 years old on average. DOD is recapitalizing this aging legacy fleet by acquiring and fielding new aircraft, namely the Air Force's F-22A, the Navy's F/A-18E/F and EA-18G, and the joint service F-35 JSF. While many F-22A, F/A-18E/F, and EA-18G aircraft have been purchased and placed into the inventory, the JSF, DOD's largest acquisition program, is still in development and has been beset by significant delays and problems. The JSF is being developed in three variants and is expected to replace most of the legacy fleets. The Air Force variant, a conventional takeoff and landing aircraft, is intended to replace the F-16 and A-10 and complement the F-22A. The Navy's carrier-capable version is intended to replace the F/A-18C/D aircraft and complement the F/A-18E/F. The Marine Corps is acquiring a short takeoff and vertical landing variant to replace its F/A-18, EA-6B, and AV-8B fleets. DOD expects to procure nearly 2,500 JSF aircraft over the next 25 years to replace similar numbers of legacy aircraft but, to date, has only taken delivery of a few test aircraft. Table 1 contains data regarding the number of each legacy and new tactical aircraft system in DOD's inventory as well as the average age and replacement system for each one.

Table 1: Legacy and New Tactical Aircraft Inventories and Planned Replacement Systems

Service	Total inventory	Average age (years)	Replacement system
Legacy systems			
F-16 Fighting Falcon	Air Force	1,135	20 JSF
F-15A-D Eagle	Air Force	379	26 ^a F-22
F-15E Strike Eagle	Air Force	223	18 TBD ^b
A-10 Thunderbolt II	Air Force	356	28 JSF
F/A-18A-D Hornet	Navy/Marine Corps	635	19 F/A-18E/F and JSF
AV-8B Harrier	Marine Corps	146	14 JSF
EA-6B Prowler	Navy/Marine Corps	94	26 EA-18G
New systems			
F-22A Raptor	Air Force	157	3 TBD
F/A-18E/F Super Hornet	Navy	393	5 TBD
EA-18G Growler	Navy	22	1 TBD ^c
Total combined inventory		3,540	

Source: DOD data; GAO analysis and presentation.

^aAverage age and replacement system reflect F-15C/D aircraft only.^bThe Air Force plans to keep F-15E aircraft in the active inventory through at least 2030; no replacement system has been identified.^cThe Navy has not officially determined the system to replace the EA-18G, but for inventory planning purposes, the Navy was directed to project the procurement of additional JSF aircraft to recapitalize the EA-18G fleet.

Air National Guard and Air Force Reserve tactical aircraft comprise roughly 40 percent of the Air Force's overall tactical aircraft inventory and are generally the oldest aircraft in the inventory. The Air Guard plays a large role in the air defense of the United States. As a result, on an annual basis the Guard performs more than 60 percent of the Air Force's air intercept missions and more than 90 percent of the ground alert missions. The Air Force Reserve Command provides a strategic reserve for the active duty Air Force, and its tactical aircraft are fully integrated with the active duty force. The Reserve Command operates four fighter and attack squadrons—made up of 90 combat ready aircraft—as well as eight associate squadrons that they share with the active duty Air Force. Going forward, the Guard and Reserves expect to have their tactical aircraft fleets recapitalized with newer F-16s and potentially F-22s from the active duty Air Force as the JSF is fielded. Both the Guard and Reserves expect to receive JSF aircraft as well.

Current Tactical Aircraft Requirements Are Lower than Previously Stated, and Service Officials Believe Risk Has Increased

DOD's combined total tactical aircraft requirement is around 3,240 aircraft. The requirement includes a mix of various types of Air Force, Navy, and Marine Corps fixed-wing fighter and attack aircraft. To achieve national security objectives, DOD not only needs to possess the right quantity of aircraft to adequately equip each service's force structure, but must also have the right mix and organization of aircraft with various capabilities. The services have reduced their inventory requirements by around 900 since 2002, to levels that service officials believe represent increased, yet manageable, risk. They emphasize that while the current quantities represent sufficient capabilities to carry out most assigned missions, they are not optimal. Officials also stated that current requirements account for capabilities provided by other weapon systems, such as unmanned aircraft and bombers, but it is unclear exactly how and to what extent.

Current Requirements Represent What Service Officials Believe Are Moderate yet Manageable Risks

The Air Force has determined that it requires a total inventory of 2,000 tactical aircraft with varying capabilities in order to meet current demands, address the most likely future demands, and protect against unanticipated contingencies. Similarly, the Department of the Navy has determined that it needs a total inventory of approximately 1,240 tactical aircraft— 820 for the Navy, and 420 for the Marine Corps.² Within their total inventory requirements, each service has identified specific quantities and mixes of aircraft needed to perform various functions, such as supporting a range of wartime missions, training, testing, and maintenance. According to service officials, the requirements are set at levels that ensure the availability of sufficient numbers and types of aircraft to support each function, with emphasis on having adequate numbers ready and able to support various possible wartime missions.

When determining requirements, the services consider the overall size of the force required to equip their force structures and meet operational demands (quantity), and the types of systems that are needed (capabilities). Consideration of these two factors means that the services must not only maintain adequate numbers of aircraft, but also must

² In 2003, the Department of the Navy began implementing a tactical aircraft integration plan aimed at more closely integrating Navy and Marine Corps strike fighter inventories, and in effect managing tactical aircraft as a common pool. This management approach is intended to provide flexibility to move aircraft between the two services and more efficiently manage the service life of each aircraft within the fleet. As a result, Navy and Marine Corps requirements are often stated as a single number.

maintain the right mix and organization of systems. The Air Force structure has 10 air and space expeditionary forces (AEF), each of which is capable of responding quickly to national security needs with a tailored and sustainable force. Air Force plans indicate that the 2,000 tactical aircraft the service believes it requires will be divided roughly equally among the AEFs.³ Similarly, the Department of the Navy shapes its tactical air force to fill 10 Navy carrier air wings⁴ and 6 Marine Aircraft Groups.⁵ Navy officials point out that factors such as the number of locations around the world in which the Navy must station aircraft carriers and the established strategic guidance and force planning constructs must also be considered when determining the Navy's overall tactical aircraft requirements. Of the current Navy requirement for 1,240 aircraft, 820 are expected to support carrier air wings and 420 are expected to support Marine Air Groups.

Officials in both services believe that while required quantities have been reduced by a combined total of around 900 aircraft since 2002, the increased risk is manageable and the forces still represent sufficient capabilities to carry out assigned missions in most cases. For example, the Air Force has reduced its required number of tactical aircraft from about 2,500 total aircraft in 2002, to 2,000 currently. This includes a recent reduction in 2009 of 250 aircraft that officials believe increases risk, but will allow the service to redistribute about \$3.5 billion over 6 years to modernize and support a smaller, but more capable force. Similarly, the Department of the Navy announced a Tactical Aviation Integration Plan in fiscal year 2002, in which the Navy and Marine Corps agreed that they

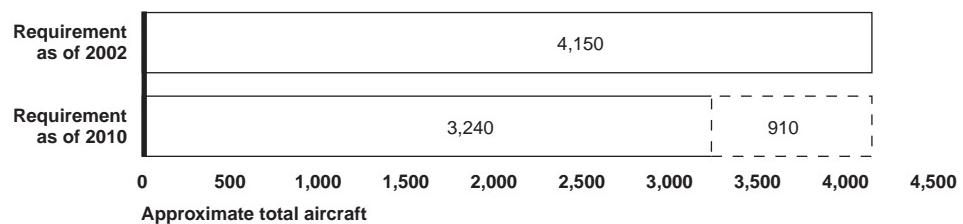
³ Each AEF is made up of various types of systems, including fighter, bomber, mobility, and electronic warfare aircraft. Air Force officials point out that the AEF structure is a rotational framework and does not drive requirements, but if the structure changes in the future, requirements may need to be revised in order to ensure that each AEF remains comprised of sufficient capabilities and capacity. In addition to the number of tactical aircraft needed in each AEF to support wartime operations, the total Air Force requirement also includes quantities for training, testing, maintenance, and attrition.

⁴ A carrier air wing generally consists of strike fighters, electronic warfare and early warning aircraft, helicopters, and delivery aircraft. Each air wing, when fully equipped, contains 44 strike fighter aircraft. In addition to the number of strike fighters assigned to the 10 carrier wings, the Navy's total tactical aircraft requirement also includes back-up and training aircraft and aircraft in for maintenance.

⁵ Marine Aircraft Groups deploy and provide the full range of combat air operations in direct support of Marine expeditionary ground forces. The Marine Corps requirement is based on the need for a total of 24 squadrons of fixed-wing strike aircraft that can be assigned to aircraft groups.

could successfully achieve their missions with fewer aircraft and units by operating as an integrated force. The Navy assumed that it would be able to perform missions more efficiently with the more advanced aircraft, namely F/A-18E/F and the JSF, and, as a result, was able to reduce its overall requirement by 497 tactical aircraft, from 1,637 to 1,140 (the Navy subsequently increased the requirement by 100 aircraft to the current total of 1,240). At the same time, the Navy reduced the number of required aircraft per carrier air wing from 46 to 44. Navy requirements officials told us that having 44 aircraft per air wing puts the Navy's ability to accomplish its missions at moderate risk, but emphasized that they believe that the risk is manageable.

Figure 1: Approximate Change in Required Tactical Aircraft Quantities, Fiscal Years 2002 to 2010



Source: DOD (data); GAO (analysis and presentation).

Because DOD anticipates that advances in technology will make future threats increasingly more difficult to counter, Navy and Air Force tactical aircraft requirements are comprised of a mix of both legacy aircraft with some upgraded capabilities and new, more advanced aircraft. The most advanced aircraft—the F-22A and the JSF, known as “fifth generation” aircraft—possess capabilities, such as low observable characteristics (stealth), data fusion from multiple sources, and advanced electronics and communications systems that the services believe are essential to conducting operations in the more advanced threat environments of the future. As a result, fifth generation aircraft are expected to make up larger portions of the services’ tactical aircraft inventories over time. By around 2025, the Marine Corps expects its entire tactical aircraft fleet to be comprised of a single fifth generation aircraft—the Short Takeoff and Vertical Landing variant of the JSF. In that same time frame, the Air Force expects more than half of its tactical aircraft force to be comprised of fifth generation aircraft—that is, F-22A and JSF. The Navy’s carrier air wings are expected to be made up of the carrier variant of the JSF and the F/A-18E/F Super Hornet.

Unmanned Aircraft and Other Types of Systems Are Considered during Requirements Analysis, but It Is Unclear How and to What Extent

DOD officials believe that they adequately considered capabilities provided by other systems including unmanned aircraft and bombers when determining their current tactical aircraft requirements. While OSD and Air Force officials note that the capabilities of other systems are routinely considered as part of the requirements determination process, significant increases of hundreds of unmanned aircraft capable of striking ground targets expected to enter DOD's inventory over the next 10 years do not appear to have directly impacted tactical aircraft requirements. This is due, in large part, to the fact that a primary driver in Air Force requirements is the ability to operate in anti-access and contested environments and unmanned aircraft are limited to operating in permissive environments. Therefore, they are not viewed as replacements for manned tactical aircraft, but instead as complementary capabilities that enable tactical aircraft to perform their missions more efficiently. Similarly, bomber aircraft play a critical role in striking ground targets. Although, Air Force officials emphasize that bomber aircraft are integral to force structure analyses and directly impact the number of fighter aircraft required, it is not clear how or to what extent.

Unmanned aircraft have proven to be highly valuable because they possess characteristics that many manned aircraft do not, such as the ability to fly for long-duration missions and provide a sustained presence over the battlefield or to perform “dull, dirty, and dangerous” missions. However, Air Force officials point out that current unmanned aircraft systems with ground strike capabilities—specifically the MQ-9 Reaper and MQ-1 Predator—do not possess other performance capabilities needed to replace manned tactical aircraft such as the F-16 or F-15. They note, for example, that the MQ-9 Reaper does not have the speed or self-protection capabilities of legacy aircraft, nor the stealth characteristics of new systems, needed to effectively operate in areas protected by advanced air defense radars. Furthermore, the satellite communications used to operate unmanned aircraft are susceptible to interruption which could compromise mission success and endanger lives. Air Force officials indicated that without “guaranteed, uninterrupted communications” and other technology advancements, unmanned systems cannot be considered viable replacements for manned aircraft. Therefore, OSD's recent direction to increase the total number of MQ-9 Reaper combat air patrols⁶ from 50 to

⁶ When fully equipped, each Reaper combat air patrol (CAP) is comprised of 4 aircraft and associated ground control equipment. Officials note, however, that the Air Force is currently operating CAPs with less than 4 aircraft in them, known as surge CAPs.

65, and procure an additional 74 Reapers from 2011 to 2015, did not result in a related decrease in the Air Force's total inventory requirement of 2,000 aircraft.

Air Force officials also noted that the service's tactical aircraft requirements assume that a new bomber, intended for long range strike missions, will be available within the next two decades. Given expected improvements in technology and more adaptive, agile assets, some service officials expect that future bombers or long-range strike assets, whether manned or unmanned, will need to be directly considered part of the tactical aircraft requirement. Air Force officials emphasize that if a new bomber is not available, a complete reassessment of the force structure will be required, a reassessment that could potentially result in an increase in tactical aircraft requirements. According to OSD officials, a new bomber will not likely be available before 2020, and in addition to bombers, the department is exploring other options for performing strike missions, including unmanned aircraft and cruise missiles.

The Navy's tactical aircraft requirement is also not affected by increases in unmanned aircraft procurement. However, the Navy has been working on developing and demonstrating technologies for a future carrier-based unmanned aircraft system that could be used to replace manned strike fighters. The technologies are still maturing, but the Naval Aviation Vision (January 2010) acknowledges the strong possibility that the Navy will eventually replace some of its carrier-based manned strike fighter aircraft—F/A-18E/F systems in particular—with unmanned systems. However, no definitive unmanned aircraft requirements have been established, and no official development program has been initiated.

DOD Expects to Encounter Tactical Aircraft Shortfalls, but Options for Minimizing These Shortfalls May Exist

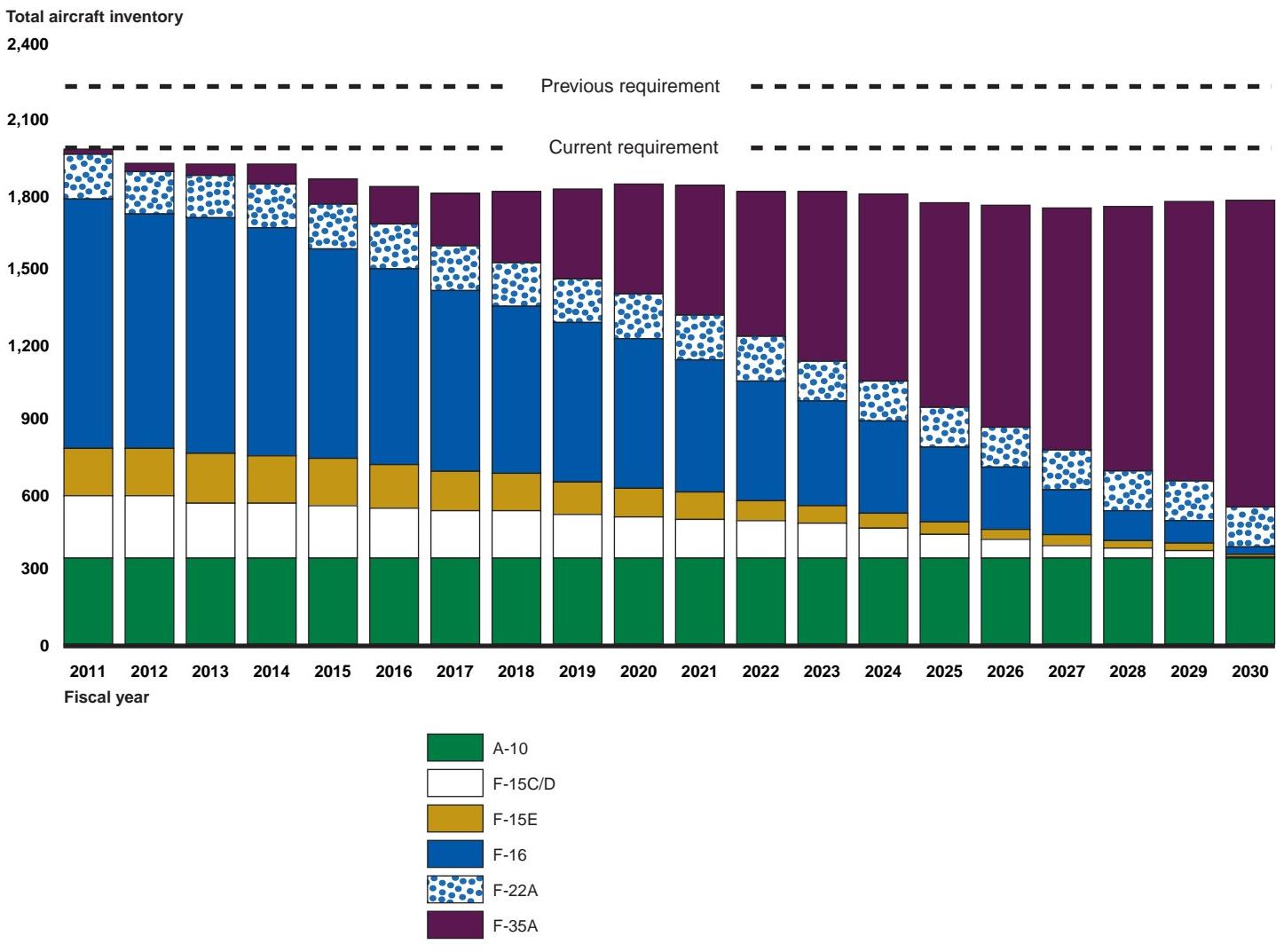
DOD expects to encounter shortfalls in both Air Force and Navy tactical aircraft inventories, but the timing and magnitude of these shortfalls largely depend on assumptions about JSF acquisitions and the viability of legacy aircraft. For example, when the Air Force assumed a higher production rate for the JSF—which now appears to be optimistic—the peak of the service's anticipated shortfall was reduced by several hundred aircraft. However, the JSF program has continued to experience problems and is in the process of being restructured, which could result in a lower production rate. In addition to JSF's problems, DOD's investments in legacy systems have generally been assigned lower priority in the budgeting process, and many critical upgrade and modernization efforts face funding shortfalls. The Navy and Air Force are exploring various options to close their projected gaps. For example, the Navy is considering

an investment of around \$7 billion to extend the service life of almost 300 F/A-18A-D aircraft, and the Air Force is looking at similar options for as many as 300 F-16s, but a fully informed cost and benefit analysis has not yet been done.

The Services Project Tactical Aircraft Inventory Shortfalls, but the Timing and Magnitude of These Shortfalls Are Uncertain

The Air Force projects a shortfall in its tactical aircraft inventory beginning in 2012 and persisting for at least two decades, even with optimistic assumptions about JSF production. According to recent data, service officials expect the number of tactical aircraft in the inventory to drop below required levels in 2012 and to continue to be below required levels through 2030. Based on information in a report the service recently submitted to Congress, the Air Force's shortfall is expected to exceed 200 aircraft in the 2025 time frame and continue to stay at about that level through 2030, the last year in the projection (see fig. 2). The assessed shortfall is likely to continue beyond 2030, absent other developments, because at that time, JSF production will have already reached its predicted peak rate, and no other new tactical aircraft procurements are yet planned.

Figure 2: Air Force Tactical Aircraft Requirements versus Projected Tactical Aircraft Inventory, 2011 through 2030



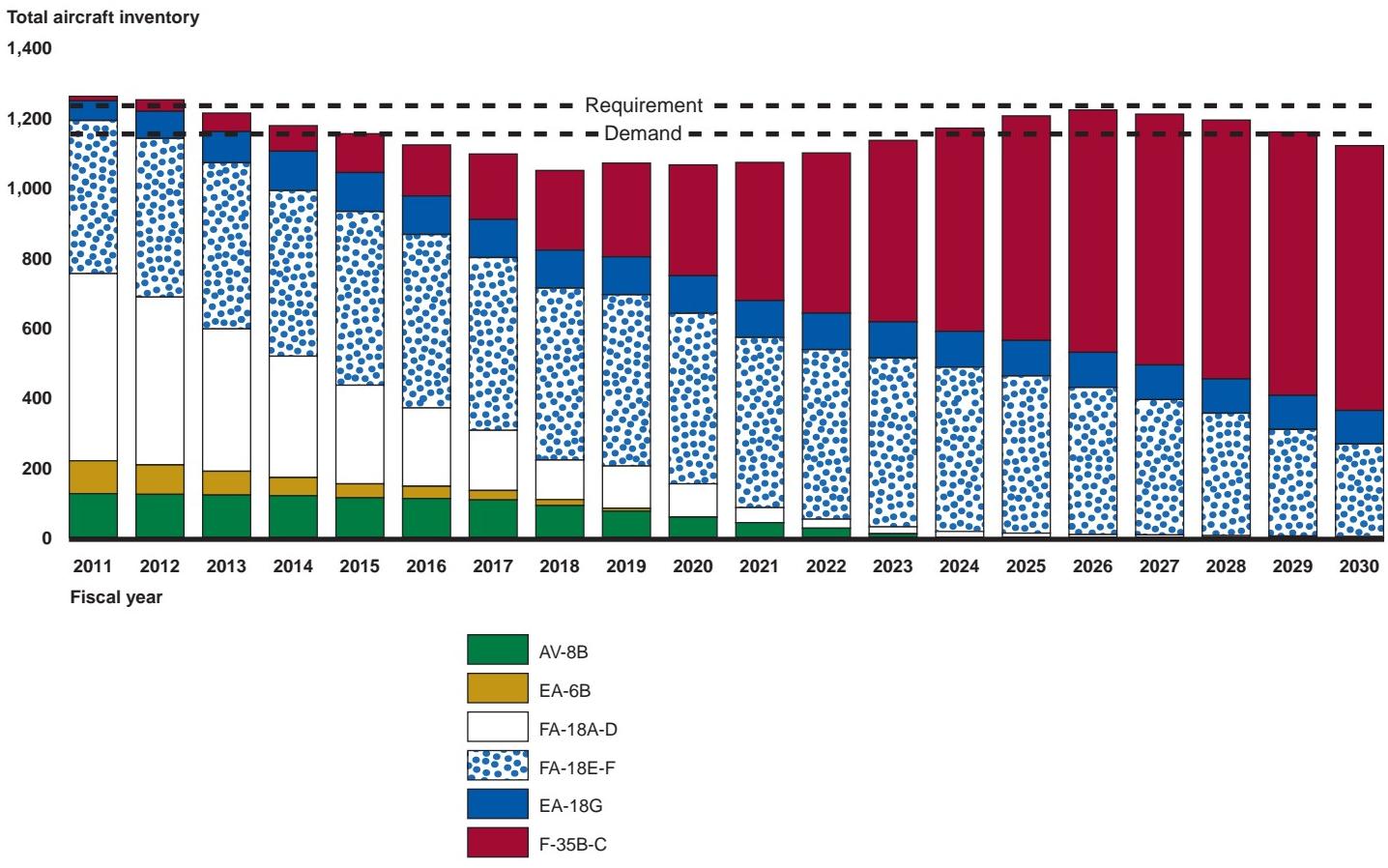
The timing and magnitude of the Air Force's projected shortfall have fluctuated over time due to changes in assumptions regarding JSF production rates, the overall requirement, and the way the Air Force calculates the service life of its aircraft. The current projected shortfall of around 200 aircraft is smaller than earlier projections had indicated. At one point, the shortfall was expected to be as large as 800 aircraft. At that time, the Air Force was assuming lower annual JSF production rates and

had an established requirement of 2,250 total aircraft. These important factors have since been revised. JSF production assumptions now reflect a higher peak production rate of 80 aircraft per year, and the requirement is now 250 aircraft less—significantly reducing the magnitude of the projected shortfall (see fig. 2 above). In addition, the Air Force has established a service-wide method of calculating aircraft service life. This new calculation accounts for both the number of flight hours and the severity of flight conditions, a calculation that the Air Force believes will improve both fleet management and force planning by providing higher quality information regarding aircraft structural life.

Like the Air Force, the Navy and Marine Corps also project a shortfall in their integrated tactical aircraft inventory, expected to peak at 177 aircraft in 2018.⁷ The Navy does not assess its shortfall against its total inventory requirement of 1,240 tactical aircraft, but instead, against the total number of aircraft needed to meet current warfighter demand within resource constraints—around 1,154. At this constrained level, the Navy and Marine Corps have fewer tactical aircraft squadrons with which to equip their respective air wings and aircraft groups—specifically five fewer Navy squadrons and four fewer Marine Corps squadrons. If assessed against the total requirement, the peak shortfall would increase by 86 aircraft to a total shortfall of 263. Figure 3 depicts the relationship between the Navy's total requirement, current warfighter demand, and the Navy's expected tactical aircraft inventory from 2011 through 2030.

⁷ Navy officials emphasize that while the Navy and Marine Corps manage their tactical aircraft as a single integrated force, the Navy's specific portion of the peak shortfall is 90 aircraft and the Marine Corps' portion is 87.

Figure 3: Navy and Marine Corps Tactical Aircraft Requirements versus Projected Tactical Aircraft Inventory, 2011 through 2030



Source: DOD data; GAO presentation.

Like the Air Force's estimates, the timing and magnitude of the Navy's tactical aircraft shortfall have fluctuated over time due in large part to changes in assumptions about new aircraft procurement and legacy aircraft service life. For example, at the time of the Navy's 2010 budget submission, the peak shortfall was projected to be 146 aircraft in about 2014—31 aircraft fewer and 4 years sooner than the current projection—because at that time the Navy assumed that it would be able to extend the service life of 295 legacy F/A-18 aircraft from 8,600 flight hours to 10,000 flight hours and that the JSF would be delivered on time and at planned rates. Since then, however, the Navy has had to revise these assumptions because the funding needed to extend the service life of the legacy F/A-18s

has not been budgeted, and the JSF program has experienced significant problems and is being restructured. As a result, the most recent shortfall projections assume that the service lives of the legacy F/A-18s will not be extended beyond 8,600 hours and reflect the fact that JSF aircraft deliveries have been delayed and quantities have been reduced by 55 aircraft between 2011 and 2015.

One key assumption consistent across the Navy's shortfall projections is that the new, more advanced F/A-18 aircraft—F/A-18E/Fs—will achieve 9,000 flight hours, which is 3,000 hours longer than their designed service life. This assumption roughly equates to an additional 10 years of service life per aircraft.⁸ While the Navy believes that this service life extension will be relatively easy to accomplish, it has not yet finished assessing the aircraft to determine the extent of the work that will have to be done. Service officials acknowledge the possibility that their assessment could uncover the need for more work than currently anticipated. Therefore, current projected inventory levels could be too high.

Air National Guard and Air Force Reserve Issues

According to the Director of the Air National Guard and other Guard officials, the impact of the Air Force tactical aircraft shortfall on the Guard is expected to be significant, largely because the Guard operates a preponderance of the Air Force's oldest aircraft, which are quickly reaching the end of their service lives. The Director believes that the Guard's portion of the shortfall will reach a critical point around fiscal year 2016. In a recent report to Congress, the Director noted that without an effective shortfall mitigation plan the Guard will lose the equivalent of four squadrons of F-16s before 2017, when the Air Force expects to have enough JSF aircraft to begin transferring its newer F-16s to guard units. The Director also points out that this potential loss of capacity directly threatens the Guard's ability to conduct air defense missions within the United States and support air expeditionary force missions overseas. However, Air Force headquarters officials emphasize that while the Guard's fighter force structure is potentially at risk in the long-term, defending the homeland remains the top Air Force priority and is not at risk.

In 2009, we reported related concerns about the impact of aging aircraft and fighter shortfalls on the Air National Guard's capability to sustain air

⁸ This number of additional years is based on Navy data indicating that the service's tactical aircraft fly an average of 300 hours per year.

sovereignty alert operations and protect United States airspace.⁹ We determined that the Air Force had not developed plans and actions to mitigate two significant challenges: (1) replacing or extending the service life of aging fighter aircraft and (2) replacing air alert units with equipment and trained personnel when they deploy or are being trained on new aircraft. Our analysis showed that by 2020, 11 of the 18 current air sovereignty alert sites could be without viable aircraft (meaning aircraft that have not yet reached the end of their useful service life). We also found that operations at 14 of 18 sites may have to suspend operations for periods of time from 2010 to 2020 as aircraft reach the end of their useful life or when units are in training on new systems.

The Air Force Reserve Command also recognizes that shortfalls in the Air Force's tactical aircraft inventory will increase the risk that future capability needs might not be met. The command expects to recapitalize its aging fleet of older F-16s with newer F-16s as the active duty Air Force transitions to the JSF. However, Reserve officials note that they are concerned that the active duty Air Force will be unable to field the JSF as planned, a situation that will likely affect the flow of aircraft down to the Reserves. This is especially troublesome since their F-16 aircraft are approaching the end of their service life.

Optimistic Assumptions about JSF Production Rates, Initial Operational Capability, and Funding Drive Estimates of the Magnitude and Timing of the Services' Inventory Shortfalls

Because of its magnitude and the hundreds of legacy aircraft it is slated to replace, the JSF is the lynchpin in DOD's tactical aircraft recapitalization plans. As a result, JSF program setbacks in costs, deliveries, and performance directly affect modernization plans and retirement schedules of the legacy aircraft. We reported in March 2010 that the JSF program continues to encounter increased costs and slowed progress and that further cost growth and delays were likely, putting at risk the ability to deliver aircraft quantities and capabilities on time.¹⁰ While noting some improvements, we determined that manufacturing inefficiencies, parts problems, and engineering technical changes indicate that design and production processes may lack the maturity needed to efficiently produce aircraft at planned rates. We also reported that, slowed by late aircraft deliveries, technical problems, and low productivity, the flight test

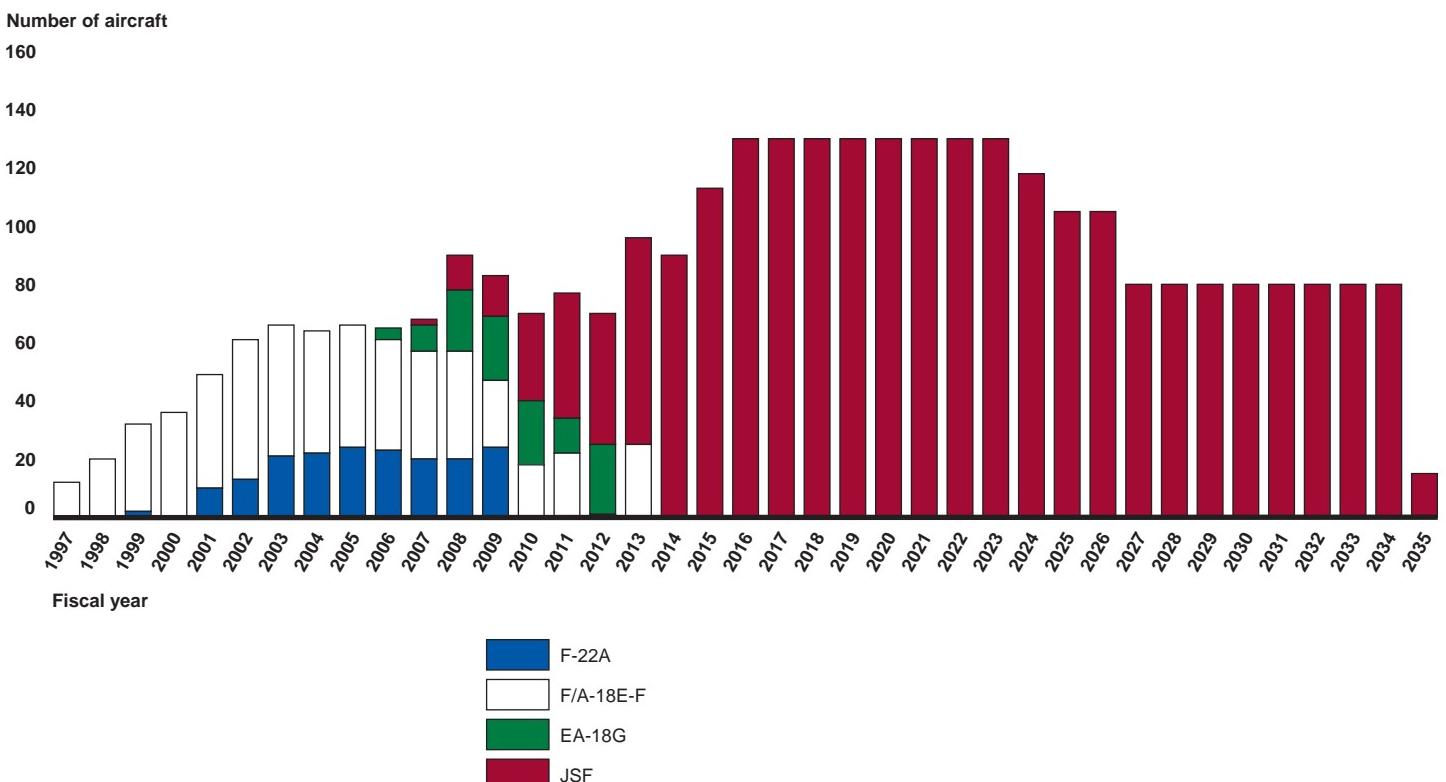
⁹ GAO, *Homeland Defense: Actions Needed to Improve Management of Air Sovereignty Alert Operations to Protect U.S. Airspace*, GAO-09-184 (Washington, D.C.: Jan. 27, 2009).

¹⁰ GAO, *Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time*, GAO-10-382 (Washington, D.C.: Mar. 19, 2010).

program only completed 10 percent of its planned sorties in 2009. Testing and other technical challenges will likely add costs and time to development and, as a result, the program may be unable to deliver promised capabilities to the warfighter in the time frame currently required. Initial operational capability, which represents full warfighting capability, has slipped several years for both the Air Force and Navy—both services now expected to achieve initial capability in 2016. The Marine Corps continues to depend on timely deliveries of JSF to meet its required initial operational capability in 2012 because of its plans to recapitalize its entire fleet of F/A-18A-D, EA-6B, and AV-8B aircraft with the short take-off and vertical landing version of the JSF.

Figure 4 below shows new tactical aircraft procurements made and expected through 2035, and underscores the prominence of the JSF in these plans. This figure reflects the assumption of a combined peak annual production rate of 130 JSF's for U.S. forces—80 Air Force aircraft and 50 Navy and Marine Corps aircraft.

Figure 4: New Tactical Aircraft Procurements between 1997 and 2035



Source: DOD data; GAO presentation.

Uncertainty about JSF's costs and deliveries makes it challenging for the services to plan and implement modernization efforts and retirement schedules. As a result, service officials have been forced to react to changing JSF schedules and to put forward unfunded contingency plans to modernize and extend the life of some legacy aircraft. For example, Navy officials have noted that they are unable to fully fund proactive efforts to detect and correct deficiencies on F/A-18A-D Hornets and AV-8B Harrier aircraft. Similarly, the low priority placed on modernizing radar on Air Force F-15E Strike Eagles has delayed procurement of sufficient numbers of more advanced active electronically scanned array (AESA) radars and threatens to ground portions of the fleet beginning in 2013 if sufficient numbers of the new radar are not available to mitigate reliability problems with the older units. Other important upgrades for the F-15E are also unfunded. All legacy aircraft in both services are becoming increasingly more expensive to operate and maintain as they age and also face issues

with parts obsolescence and/or diminishing manufacturing sources, which threaten to further increase sustainment costs for the affected systems and place additional cost pressures on the tactical aircraft portfolio as a whole. See appendix III for details and further information about the legacy aircraft and new acquisitions.

As a result of the JSF program's continuing cost and schedule problems, the Secretary of Defense mandated a restructuring of the program in February 2010. Among other things, this restructuring increased time and funding for system development, added 13 months and 4 additional aircraft to the test program, and reduced near-term procurement quantities. Our March report noted that these and other positive steps, if implemented effectively, should improve program outcomes and provide more realistic projections of cost and schedule.¹¹ However, the program continues to face significant risks that will likely add to costs and further delay aircraft deliveries. The combination of significant development cost increases and reduced procurements resulted in unit cost increases that exceeded statutory thresholds, requiring DOD to certify the need for the program to Congress.¹² According to the December 2009 Selected Acquisition Report for the JSF, program unit costs are 57 percent higher than the original baseline. However, this figure represents cost estimates from the latest independent analyses through fiscal year 2015¹³ only. Estimated program costs from fiscal year 2016 through the end of procurement in 2035 are still based on the Joint Program Office's estimates, which some DOD officials consider overly optimistic.

¹¹ GAO-10-382; and GAO *Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program*, GAO-10-520T (Washington, D.C.: Mar. 11, 2010).

¹² 10 U.S.C. § 2433 establishes the requirement for DOD to prepare unit cost reports on major defense acquisition programs or designated major defense subprograms. Two measures are tracked: procurement unit cost (total funds programmed for procurement divided by the total number of fully configured end items to be procured) and program acquisition unit cost (total cost of development, procurement, and system-specific military construction divided by the number of fully configured end items to be procured). To eliminate the effects of inflation, costs are expressed in constant base year dollars. If a program exceeds cost growth thresholds specified in the law, it is referred to as a Nunn-McCurdy breach and DOD is required to report the breach to Congress. 10 U.S.C. § 2433a requires a certification to Congress in order for DOD to continue the program.

¹³ This reflects the timeline of the Future Years Defense Program outlined in the fiscal year 2011 President's Budget. The original unit-cost reporting baseline was established in October 2001, and cost increases are expressed in base year 2002 dollars.

The Services Are Exploring Options and Identifying Near-Term Funding Needs for Addressing Projected Shortfalls, but Lack Information Needed for Sound Decision-Making

The Air Force has several options for addressing its projected tactical aircraft shortfall. These options, which were identified and assessed in two reports issued to Congress in March 2010,¹⁴ include extending the service life of and modernizing legacy F-16 aircraft, increasing annual JSF procurement to more than the 80 aircraft per year, and procuring new upgraded variants of legacy aircraft such as the F-16 and F-15. The Air Force notes in both reports, that by making investments in its older legacy F-16 aircraft, it could mitigate the shortfall through 2015. Furthermore, the Air Force believes that by extending the service life of and modernizing 300 newer legacy F-16s, along with procuring JSF at the planned rate of 80 aircraft per year, it could mitigate the shortfall through 2030. However, Air Force Reserve officials emphasize that the older F-16 aircraft are not part of the Air Force's service life extension plans. They point out that the small investment in the older F-16s, noted by the Air Force, would allow those aircraft to simply reach their intended service life of 8,000 flight hours, but would not extend their service life.

Initial funding for F-16 service life extension and modernization efforts is expected to be part of the Air Force's 2012 budget request, but the full cost is not yet known. The Air Force's analysis supporting its report assumed that extending the service life of newer F-16s would cost approximately \$2.6 billion (in 2010 base year dollars), but the report points out that full-scale fatigue testing of a newer F-16 has to be completed before any feasibility or cost and benefit analysis can be fully informed. According to officials responsible for maintaining and sustaining the F-16 fleet, such testing is not expected to begin until around May 2011. They also note that the testing will take approximately 3 years from set-up to reporting and is estimated to cost \$38 million.

Two other options examined by the Air Force are the possibility of increasing JSF procurement to more than 80 aircraft per year and purchasing new, upgraded variants of legacy aircraft, such as the F-16 and F-15, referred to as "4.5 generation" aircraft. The Air Force notes that higher annual JSF procurements could reduce unit costs while quickly transitioning the inventory to a higher ratio of fifth generation aircraft. However, JSF procurement acquisition unit cost has increased 57 percent

¹⁴ The National Defense Authorization Act for Fiscal Year 2010 required the Secretary of the Air Force and the Secretary of Defense each to submit a report to the congressional defense committees that addressed the Air Force's projected tactical aircraft shortfall. Pub. L. No. 111-84, §§ 131 and 1075 (2009). Both reports were submitted to the committees by the Air Force in March 2010.

from original estimates, and some service officials question whether the Air Force will be able to afford the current planned procurement of 80 aircraft per year. With regard to purchasing 4.5 generation aircraft, the Air Force does not believe that this option supports the appropriate mix of legacy and stealth aircraft needed for future warfighting scenarios. In addition, it believes that extending the service life of existing fighters would provide essentially the same capability at 10 to 15 percent of the cost. This cost comparison, however, is based on an analysis that was not informed by the results of a full scale fatigue test of existing fighters, and did not include the costs associated with the unique sustainment equipment and personnel that would be required to support 4.5 generation aircraft.

The Director of the Air National Guard agrees with the Air Force's assessment of the shortfall mitigation options, but believes that an additional option—one that addresses its specific shortfall—may exist. This additional option is to move 6 aircraft, and associated personnel and support equipment, out of each active duty squadron and into guard units, thereby reducing the number of primary aircraft assigned to each active duty squadron from 24 to 18. The Guard believes that, among other benefits, this would produce more than 180 combat ready aircraft to recapitalize its aging fleet, and allow for a more even distribution of aircraft utilization and better balance aircrew and maintenance personnel experience between active and Guard units. The Guard believes that this approach would maximize the amount of combat power that can be generated within resource constraints. However, the official Air Force position is that the affect of the shortfall on the Guard is minimal over the next several years. Therefore, some Air Force headquarters officials are resistant to this option, in large part because they believe that reducing the number of aircraft in each squadron will negatively affect mission efficiency with respect to force rotation.

As part of its 2012 budget preparations, the Navy is exploring the possibility of funding a service life extension program for approximately 280 legacy F/A-18 aircraft in order to address its projected tactical aircraft shortfall in the near term. This program would extend the lives of the aircraft from 8,600 to 10,000 flight hours, thus, according to the Navy, reducing the peak of the shortfall from 177 to less than 50 aircraft. While the Navy has funded some F/A-18 structural upgrades over the past several years, it has not yet budgeted funding for this service life extension program. The Navy estimates that, on average, this program will cost \$25.1 million per aircraft, or a total of more than \$7 billion. Nearly all of that cost is expected to go toward buying the parts and equipment needed to make

structural upgrades and address parts obsolescence issues. Navy officials emphasize that the program is also expected to purchase some additional capabilities.

The Navy is also exploring other options for addressing the near term impacts of its projected shortfall, including: reducing the number of expeditionary squadrons; accelerating the scheduled transition of several legacy F/A-18 squadrons to available F/A-18E/F aircraft; and, changing the way the aircraft carrier fleet is managed and used. Navy officials note that exercising some of these options—like adjusting the way the carrier fleet is managed and used—would only be possible if current demands on the force change and point out that each option must be balanced against operational requirements.

In 2007, we noted that one option available to the Navy was simply to buy more new F/A-18E/F aircraft. Since the F/A-18E/F production line is still running, the option remains viable, but the Navy does not appear to include it in any of its analyses. During a congressional hearing in March 2010, senior Navy officials did not provide a direct answer when asked if they had compared the cost of buying new F/A-18E/F with the estimated cost of extending the service lives of legacy aircraft. Our analysis, detailed below and summarized in table 2, using the Navy's most recent estimates and data from the December 2009 Selected Acquisition Reports, indicates that buying additional aircraft has the potential to provide a better return on investment as measured by the cost per additional flight hour.¹⁵

As noted above, the Navy expects the service life extension program, if funded and executed, to result in 1,400 additional flight hours per legacy aircraft—from 8,600 to 10,000 hours. Given that the estimated cost of the program will be \$25.1 million per aircraft, the average cost per additional flight hour would be \$17,929. If the Navy were to procure 100 additional F/A-18E/F aircraft—a number roughly equivalent to its projected shortfall—at a procurement unit cost of \$61 million, which is the unit cost for the aircraft being procured in 2011, the cost per additional flight hour, assuming a 6,000 flight hour service life, would be \$10,167. Even if the new F/A-18E/F aircraft were procured at a unit cost of \$76 million, the same unit cost as the 25 aircraft being procured in 2013, the cost per additional

¹⁵ Our analysis was done using data from the F/A-18E/F December 2009 Selected Acquisition Report and assumptions about procurement quantities and additional flight hours. The analysis is only intended to provide points for discussion and is not a rigorous, comprehensive cost estimate.

flight hour would still be less than the cost of each hour added by the service life extension option—\$12,667 versus \$17,929 per hour. The cost per additional flight hour reaches a breakeven point at a unit cost of roughly \$105 million. This analysis assumes that each new F/A-18E/F would have a 6,000 flight hour service life, but as noted above the Navy believes that the aircraft will be able to achieve 9,000 flight hours. If so, the option of buying new aircraft becomes even more attractive.

Table 2: Comparison of Procuring New F/A-18E/F Aircraft and Extending the Service Life of Legacy Aircraft

Options	Number of aircraft	Average cost per aircraft	Additional flight hours per aircraft	Average cost per additional flight hour
Service life extension	280	\$25,100,000	1,400	\$17,929
Buy new F/A-18E/Fs at FY11 unit cost	100	61,000,000	6,000	10,167
Buy new F/A-18E/Fs at FY13 unit cost	100	76,000,000	6,000	12,667

Source: Navy data; GAO analysis and presentation.

Services Have Not Considered Future Requirements in Light of Recent Strategic Planning and Threat Assessment Changes

DOD's current tactical aircraft requirement does not fully reflect recent changes in strategic planning and threat assessments, as reported in OSD's 2010 QDR,¹⁶ because the foundational analyses have not been done. The QDR is expected to articulate the nation's defense strategy and identify associated budget plans. As such, it provides a starting point from which DOD assesses its needs and establishes its requirements. According to service officials, the 2010 QDR effectively validates the services' existing force structures and focuses on the near-term, principally the next 6 years. Furthermore, OSD's recent Aircraft Investment Plan¹⁷ and fiscal year 2011 budget decisions made some changes in near-term aircraft investments, such as increasing purchases of unmanned aircraft and electronic warfare systems, but did not change the current tactical aircraft requirement. However, the QDR reflects a fundamental change in how DOD views

¹⁶ DOD conducts a comprehensive examination of the national defense strategy, force structure, and force modernization plans every 4 years, as directed by 10 U.S.C. §118 (2004).

¹⁷ The Secretary of Defense is required to submit an annual long-term plan for the procurement of fixed-wing aircraft with the defense budget materials for each fiscal year as directed by 10 U.S.C. § 231a. DOD submitted its first annual report in February 2010.

future national security challenges by examining them in various combinations and recognizing the need to plan for and acquire systems, including unmanned aircraft, that are adaptive and agile. Although the QDR report has been released, the department is still in the process of establishing the more detailed analytical foundation for its future requirements and, until the analyses are complete and a foundation in place, it will be difficult for DOD to make informed investment decisions about legacy aircraft upgrades and modernizations and new aircraft procurements.

Current Tactical Aircraft Requirements Do Not Fully Reflect Recent Changes in Strategic Planning and Threat Assessments

Changes in DOD's planning assumptions and threat assessments reflect a fundamental shift in the department's view of the various national security challenges the U.S. may face in the future, but current tactical aircraft requirements and shortfall projections are primarily based on previously established assumptions and assessments largely focused on fighting and winning two major regional conflicts. Air Force officials note that the 2010 QDR could actually result in an increase in tactical aircraft requirements because it includes demands in addition to "deterring and defeating two regional aggressors." Specifically the QDR states that "U.S. forces today and in the years to come can be plausibly challenged by a range of threats that extend far beyond the familiar 'major regional conflicts' that have dominated U.S. planning since the end of the Cold War." Therefore, the 2010 QDR conveys DOD's assessment of the force structure and capabilities needed to meet many types of demands by presenting three scenario combinations that reflect both current and projected security environments. Each scenario includes a different combination of types of operations, ranging from engaging in major stabilization operations, deterring and defeating two regional aggressors, conducting counterinsurgency, maintaining a long-duration deterrence operation, and extending support to civil authorities. According to DOD officials, this approach to planning provides a more realistic picture of the future, but makes quantifying long-term requirements difficult.

While the 2010 QDR presents changes to previous assumptions and threat assessments, it does not significantly change the department's tactical aviation force structure requirements. The QDR establishes force structure parameters through fiscal year 2015 at 10 Navy carrier air wings, six Marine Corps fixed-wing aircraft groups, and an Air Force component comprised of 10 to 11 strike fighter and 6 air superiority wing-equivalents. These parameters generally reflect and, according to service officials, validate the current tactical aviation force structure. Furthermore, service

officials continue to cite as official force requirements those requirements that were in place prior to the QDR's publication.

The 2010 QDR's focus on both near-term and long-term needs does, however, affect tactical aviation forces. In connection to the force structure plan it lays out, the QDR states that "whereas QDRs have often emphasized shaping the force beyond the five-year time frame, this QDR, of necessity, had to focus intensively on present conflicts as well as potential future needs. Our force-sizing construct therefore takes into account the realities of the current operational environment." As part of this new dual focus, the QDR directs more investment be made in various enabling capabilities designed to significantly enhance the ability of U.S. forces to protect and advance U.S. interests in both the near and longer term. Some of these capabilities are tactical aircraft capabilities, including more and better intelligence, surveillance, and reconnaissance (ISR), and electronic warfare systems. OSD's recent budget decisions and its Aircraft Investment Plan for fiscal years 2011 through 2040— informed by early QDR analysis—focus on the near-term and make corresponding changes to aircraft investments. OSD's Resource Management Decision number 700, also made a number of changes to the military services' aircraft investment plans for the next 5 years, including

- adding \$1.8 billion to procure 74 additional MQ-9 Reapers;
- adding \$344 million to develop, procure, and integrate jamming pods on 33 MQ-9 aircraft to counter improvised explosive devices and address other irregular warfare needs;
- adding \$4 billion to procure 26 additional EA-18G aircraft to continue the Navy's expeditionary airborne electronic attack mission;¹⁸
- adding \$2 billion to fund the development of a carrier-based unmanned aircraft system, beginning in 2013; and
- reducing JSF procurements by 122 aircraft between fiscal years 2011 and 2015, and adjusting resources to fully fund the restructured JSF program to recent independent cost estimates

DOD's Aircraft Investment Plan reflects these budget actions and is shaped by and implements some of the QDR's near-term initiatives relating to electronic warfare and ISR. The plan also creates a new "unmanned multirole surveillance and strike" category, distinct from fighter/attack and

¹⁸ OSD directed the Navy to recapitalize four joint expeditionary EA-6B squadrons that the service was planning to retire in 2012. In Resource Management Decision number 700, OSD provided funding for 26 additional EA-18Gs to continue supporting all services through the land-based, expeditionary airborne electronic attack mission.

ISR, for aircraft systems such as the MQ-9 Reaper and the contemplated carrier-based unmanned aircraft system. However, despite a growing consensus that unmanned systems offer increasingly sophisticated attack capabilities that complement existing tactical aircraft, plans to procure additional unmanned assets, as discussed earlier in this report, have thus far not impacted the service's existing tactical aircraft requirements.

In our 2007 report, we recommended, and DOD agreed, that the department develop an integrated and affordable enterprise-level investment strategy based on a joint assessment of warfighting needs and a full set of potential and viable solutions, considering not only new acquisitions, but also modifications to legacy aircraft within realistic and affordable resource constraints.¹⁹ We noted that this strategy should strike a balance between maintaining near-term readiness and addressing long-term needs, considering the contributions of unmanned aircraft systems, bombers, long-range strike aircraft, missiles, and other weapons currently in the inventory and those planned that can be employed to perform missions similar to those performed by tactical aircraft. DOD's Aircraft Investment Plan is a step in the right direction. However, while the Aircraft Investment Plan's cost estimates and projections account for new procurements through 2015, they do not include the considerable investments that could be needed to upgrade legacy assets.

Foundational Analyses to Determine Future Tactical Aircraft Requirements Have Not Yet Been Conducted

The QDR is to set a long-term course for DOD to follow and provide a strategic framework for the department's budget plan and force management decisions. As such the 2010 QDR reflects changes to previous planning assumptions and threat assessments that could impact future tactical aircraft requirements. However, detailed analyses of the foundational capability requirements, which reflect current QDR guidance and assumptions and which are needed to provide the framework for determining future tactical aircraft requirements and for making related investment decisions, are not yet complete. For example, an Air Force official stated that, even though the QDR has been published, joint analytics are ongoing to establish acceptable scenarios on which to base force planning. The updated "joint analytics agenda" will provide the basis for any requirements changes resulting from the QDR. Until then, the Air Force is operating from the previously established framework, and it is therefore unclear whether current Air Force requirements accurately

¹⁹ GAO-07-415.

reflect long term needs. Marine Corps requirements officials said they had not been fully briefed on the QDR scenarios and assumptions.

Once complete, these analyses could result in changes to prior assumptions and projections regarding future force structure needs. These changes, in turn, will impact investment decisions regarding legacy aircraft modernization and service-life extension programs, JSF procurements, and other capabilities. While these decisions and others, such as those involving retirement of older aircraft and production quantities and schedules for the JSF, will be made in the near-term, they will have long-term funding and capability implications. Therefore, these decisions must be adequately informed and based on the most up-to-date data available on force structure requirements.

Conclusions

Current tactical aircraft requirements have been set at levels that service officials believe are sufficient to meet national security needs with moderate, but manageable risk. At the same time, the services continue to report that their tactical aircraft inventories will soon fall below required quantities—shortfalls they expect to persist for years. As a result, DOD faces important investment decisions in the upcoming budget cycle. However, the magnitude and timing of projected shortfalls are uncertain and heavily dependent on assumptions about JSF production rates and deliveries, as well as investments in legacy aircraft. OSD's 2010 QDR and Aircraft Investment Plan for fiscal years 2011-2040 focus on the near-term, and a more detailed framework for determining long-term requirements has not yet been established. In addition, the Aircraft Investment Plan addresses investments in new procurements, as directed by Congress, but does not include the considerable amount of money that could be needed to upgrade legacy assets. Given the inherent uncertainty in planning for future events, it is unlikely that perfect knowledge will ever be attained, but DOD must gain a clearer and more comprehensive understanding of its tactical aircraft requirements and potential shortfalls to ensure that upcoming investment decisions are adequately informed.

The pending restructure of the JSF program could provide more realistic expectations of what the program is capable of delivering in the next few years. If JSF quantities are reduced or deliveries slip into future years, billions of dollars more in as yet unbudgeted funding may be required to sustain, modernize, and extend the life of legacy aircraft. Until the JSF restructuring is complete, and DOD determines how to account for tactical capabilities provided by unmanned aircraft, it will be difficult for DOD to make informed investment decisions about legacy aircraft upgrades and

modernizations, and new aircraft procurements. In addition, without a joint comprehensive analysis that compares and contrasts the costs and benefits of various Air Force and Navy options for addressing inventory shortfalls, it will be difficult to determine the most efficient and effective approach to meeting established requirements to mitigate shortfalls or, alternatively, eliminate redundancies.

Matter for Congressional Consideration

To ensure that DOD's future Aircraft Investment Plans are more complete, balanced, and comprehensive, Congress should consider modifying the reporting requirements of future Plans to include not only acquisition costs for new procurements, but also investments for modernizing and sustaining legacy aircraft, including service life extension programs.

Recommendations for Executive Action

To address the uncertainty surrounding projected tactical aircraft shortfalls, we recommend that the Secretary of Defense, working with the Secretaries of the Air Force and the Navy, more clearly explain the department's requirements and the size and severity of anticipated tactical aircraft shortfalls, identify the key assumptions underlying shortfall projections, and identify alternatives and associated costs to mitigate the impact.

We also recommend that the Secretary of Defense more directly and clearly articulate how the complementary capabilities provided by unmanned aircraft, bombers, missiles, and other weapon systems are accounted for and quantified when calculating tactical aircraft requirements.

To ensure that upcoming investment decisions are fully informed, we recommend that when reassessing tactical aircraft requirements and potential shortfalls, the Secretary of Defense also complete a comprehensive tactical aircraft analysis that compares and contrasts the costs and benefits of extending the lives of legacy aircraft with the costs and benefits of procuring additional new aircraft including the F-22, JSF, F/A-18E/F, F-15E, and newest block F-16. This analysis should be provided to the Congress with the defense budget in February 2011 and include

- an assessment of the technological and manufacturing feasibility of each option;
- an evaluation of the pros and cons for each option in terms of combat effectiveness and desirability from the warfighter's perspective;

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- identification of data sources and explanation of underlying assumptions; and identification of potential sources of funding for the various options including the deferment of JSF procurements into the future.

Agency Comments and Our Evaluation

DOD provided us with written comments on a draft of this report. The comments appear in appendix IV. DOD also provided technical comments that were incorporated as appropriate. During the agency comment period, DOD requested clarification regarding our first recommendation. As a result, we revised the recommendation to more clearly state that the Secretary of Defense, working with the service secretaries, should clarify the uncertainty surrounding DOD's projected tactical aircraft shortfalls.

DOD partially concurred with the revised version of our first recommendation that the Secretary of Defense more clearly explain the department's requirements and the size and severity of anticipated shortfalls, identify the key assumptions underlying shortfall projections, and identify alternatives and associated costs to mitigate the impact. The department believes that the Air Force and Navy have provided this type of information to Congress in the past and notes that the services intend to do so again in support of their fiscal year 2012 budget requests. The department also emphasized that requirements and inventory trends change over time as the strategic environment evolves. Although the services have provided Congress with some information, it has generally been limited to summary level data and has not provided a clear and comprehensive understanding of underlying assumptions or how the projections were calculated. As noted in our report, we recognize that there is inherent uncertainty in planning for future events and requirements and projected inventory shortfalls are critically dependent on a number of factors that can change over time. However, we continue to believe that DOD needs to provide additional clarity regarding the basis for its tactical aircraft requirements and anticipated shortfalls to ensure that Congress and DOD officials have adequate information when making upcoming investment decisions.

DOD concurred with our second recommendation that the Secretary of Defense more directly and clearly articulate how complementary capabilities are accounted for and quantified when calculating tactical aircraft requirements. DOD noted that multiple analyses and studies examining the aviation portfolio are being conducted with the intent of achieving the correct balance of capabilities and capacity. As these analyses are done, we believe it is important that DOD provides a clear

understanding of how other types of systems such as unmanned aircraft and bombers directly impact tactical aircraft needs.

DOD partially concurred with our third recommendation that the Secretary of Defense complete a comprehensive analysis comparing the costs and benefits of extending the lives of legacy aircraft with the costs and benefits of procuring additional new aircraft. DOD noted that as part of its fiscal year 2012 budget preparations, it is assessing tactical aircraft costs and capabilities, and focusing on platforms and systems that require near term decisions. However, it is not clear from DOD's response if the assessment being done is a comprehensive cost and benefit analysis or if it includes any of the following elements

- an assessment of the technological and manufacturing feasibility of each option;
- an evaluation of the pros and cons for each option in terms of combat effectiveness and desirability from the warfighter's perspective;
- identification of data sources and explanation of underlying assumptions; and
- identification of potential sources of funding for the various options including the deferment of JSF procurements into the future.

Therefore, we reiterate the need for an assessment that contains these elements.

DOD partially concurred with our recommendation that future versions of its Aircraft Investment Plan should not only address new acquisitions, but should also include investments in modernization and sustainment of legacy aircraft. The department's response indicated that this additional information would not likely be included in future versions of the Plan because it is not currently required by Congress. However, to provide decision makers with more complete and comprehensive information we believe that future versions of the Plan need to include an examination of the costs and benefits of modernizing and sustaining legacy aircraft. Therefore, we have changed our original recommendation to a matter for congressional consideration.

As arranged with your office, unless you publicly announce the contents earlier, we plan no further distribution of this report until at least 5 business days after its issue date. At that time, we will send copies of this report to the Secretary of Defense, the Secretary of the Army, the Secretary of the Air Force, the Secretary of the Navy, the Commandant of

the Marine Corps, and the Director, Office of Management and Budget. The report will also be made available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or sullivanm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report were Bruce Fairbairn, Assistant Director; Michael Aiken; Julie Hadley; Travis Masters; and Andrew Redd.

A handwritten signature in black ink, appearing to read "Michael J. Sullivan".

Michael J. Sullivan, Director
Acquisition and Source Management

Appendix I: Scope and Methodology

To identify DOD's current tactical aircraft requirements, we compiled and analyzed data related to DOD's stated requirements and current tactical aircraft inventories. We met with Air Force, Navy, and Marine Corps requirements officials to discuss their respective services' requirements and to gain an understanding of how those requirements were established. We also discussed how capabilities provided by other weapon systems are considered in the requirements determination process. We reviewed key requirements documents including the National Defense Strategy, National Military Strategy, 2010 and prior Quadrennial Defense Review reports, Guidance for Development of the Force, and DOD's Aircraft Investment Plan Fiscal Years 2011-2040, as well as service-level planning documents and briefings.

To determine the extent to which DOD's plans for acquiring new aircraft and modernizing and retiring legacy aircraft are likely to meet its current requirements, we compared current Air Force and Navy—including Marine Corps—inventory projections with the established requirements. We met with service requirements and long-range planning officials to identify the planning factors and assumptions underlying the service inventory projections. We also assessed the progress being made in developing and fielding replacement systems, specifically the JSF, and also analyzed plans for and progress in modernizing and retiring legacy aircraft. We likewise identified and assessed various recapitalization and force structure efforts, underway and planned, that the services believe will help them meet their stated tactical aircraft requirements. We analyzed the cost and performance implications of some of the efforts using data and information obtained from DOD and service documents.

To determine how changes in DOD's strategic planning and threat assessments, as reported in its 2010 QDR, and recent investment decisions have impacted tactical aircraft requirements we analyzed changes in the threat environment as described in current and prior QDR reports and other strategy documents. We examined how changes in the threat environment are noted in force planning guidance and incorporated into service-level plans. We analyzed fleet and force structure changes, including planned investments and acquisition strategies, relating to the tactical aircraft systems in our review, and examined the assumptions upon which these changes and plans were based.

In performing our work, we obtained documents, data, and other information from Air Force requirements officials at Air Combat Command, Langley Air Force Base, Virginia, and Navy requirements officials at the Pentagon, Arlington, Virginia. We also met with Air Force,

Navy, and Marine Corps headquarters, and OSD officials in Washington, D.C.; as well as Air Force, Navy, and Marine Corps system program offices at Wright-Patterson Air Force Base, Ohio, and Patuxent River, Maryland, to discuss service requirements and individual tactical aircraft systems. The program officials we met with represented the JSF program as well as the Air Force F-16, F-15, A-10, F-22A, and MQ-9 systems, and the Navy and Marine Corps F/A-18, EA-6B, AV-8B, and EA-18G systems. We drew extensively on prior GAO work related to the JSF program, tactical aircraft requirements, and force planning, and reviewed the analyses and assessments of other government agencies and non-governmental organizations.

To assess the reliability of DOD's requirements, inventory, cost, schedule, and performance data we talked to knowledgeable agency officials about the processes and practices used to generate the data. We also corroborated the data by reviewing relevant documentation from various sources. We determined that the data were sufficiently reliable for the purposes of this report.

We conducted this performance audit from September 2009 to July 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Tactical Air Forces Funding, Fiscal Years 2011 through 2015

Then-year dollars in millions

	2011	2012	2013	2014	2015	2011-2015
Air Force						
Military construction	\$727.3	\$537.4	\$436.9	\$561.2	\$504.0	\$2,766.8
Military personnel	10,643.3	10,924.4	11,216.5	11,621.2	12,043.2	56,448.4
Operations and maintenance	14,800.8	14,822.1	15,334.5	16,069.5	17,028.9	78,055.8
Procurement	11,261.6	11,686.9	12,159.5	14,108.2	15,178.5	64,394.7
Research, development, test and evaluation	6,542.4	6,976.8	6,287.9	4,720.9	4,076.4	28,604.4
Marine Corps						
Military construction	0	0	0	0	0	0
Military personnel	2,054.7	2,232.7	2,299.3	2,371.4	2,449.9	11,408.1
Operations and maintenance	956.6	1,044.3	1,077.9	1,091.7	1,137.3	5,307.8
Procurement	2,934.4	3,199.0	4,728.4	4,379.3	4,497.7	19,738.7
Research, development, test and evaluation	667.9	594.0	529.8	375.9	134.7	2,302.4
Navy						
Military construction	0	0	0	0	0	0
Military personnel	1,392.7	1,461.5	1,508.2	1,558.7	1,613.1	7,534.3
Operations and maintenance	2,522.5	2,633.8	2,703.8	2,850.3	2,999.0	13,709.4
Procurement	8,535.2	9,132.6	9,233.2	7,812.7	7,659.0	42,372.8
Research, development, test and evaluation	1,041.9	941.5	754.2	570.3	306.3	3,614.2
Total DOD						
Military construction	727.3	537.4	436.9	561.2	504.0	2,766.8
Military personnel	14,090.7	14,618.6	15,024.0	15,551.3	16,106.2	75,390.8
Operations and maintenance	18,279.9	18,500.2	19,116.2	20,011.5	21,165.1	97,072.9
Procurement	22,731.2	24,018.5	26,121.1	26,300.3	27,335.3	126,506.3
Research, development, test and evaluation	8,252.2	8,512.3	7,571.9	5,667.1	4,517.5	34,520.9
Grand Totals	\$64,081.3	\$66,186.9	\$68,270.1	\$68,091.4	\$69,628.1	\$336,257.8

Source: DOD's 2011 Future Years Defense Program.

Note: Numbers may not add because of rounding.

Appendix III: Summary of Tactical Aircraft Systems Ongoing and Future Efforts

This appendix provides more details on new and legacy tactical aircraft expanding upon summary information provided in the body of this report. We include a brief description of each aircraft's mission, program status, and our observations on program execution and outcomes. Where applicable, we also highlight recent GAO work on some systems. The appendix also includes a funding table for each aircraft that contains the fiscal year 2011 budget request and projected funding needs through fiscal year 2015. The budget information in these tables is expressed in current (then-year) dollars, and the totals may not add exactly because of rounding.

Figure 5: F-35 Lightning II, Joint Strike Fighter



Source: Lockheed Martin.

Initial Operational Capability (planned): 2012 (Marines), 2016 (Air Force & Navy)

Aircraft Inventory: 0 (production aircraft)

Average Age of Aircraft: 0

System Description

The Joint Strike Fighter (JSF) program's goals are to develop and field an affordable and highly common family of stealthy, fifth-generation, strike fighter aircraft for the Navy, Marine Corps, Air Force, and U.S. allies. The carrier suitable variant will provide the Navy a multi-role, stealthy, strike aircraft to complement the F/A-18E/F Super Hornet. The conventional take-off and landing variant will primarily be an air-to-ground replacement for the Air Force's A-10 and F-16 aircraft, and will complement the F-22A Raptor. The short take-off and vertical landing variant will be a replacement for the Marine Corp's AV-8B and F/A-18 aircraft.

Program Status

JSF concept demonstration began in November 1996. The program entered system development and demonstration in October 2001 and is

now expected to be completed in April 2016, more than 2 years later than planned in the acquisition baseline that was approved in 2007. Because of continuing cost and schedule problems, the Secretary of Defense directed a comprehensive restructuring of the JSF program in February 2010. In addition, cumulative cost and schedule increases resulted in a critical Nunn-McCurdy breach of the original baseline. Overall, the cost estimate to complete development has increased from \$34.4 billion in the 2001 original baseline to \$51.8 billion currently, an increase of \$17.4 million or 51 percent. Estimated procurement costs have increased from \$196.6 billion in the 2001 baseline to a current estimate of \$325.1 billion, an increase of \$128.5 billion, or 65 percent. During that same period, the expected procurement quantity for the U.S. decreased from 2,852 to 2,443 aircraft.

The JSF program is the Department of Defense's (DOD) most costly and ambitious aircraft acquisition program and the linchpin of the long-term plans to recapitalize the Air Force, Navy, and Marine Corps tactical air forces. DOD estimates that the total cost to develop and procure its fleet of aircraft will be about \$323 billion. The estimated total investment, including the cost to maintain and operate the JSF over its expected life, exceeds \$1 trillion. Eight partner countries are providing funding for system development and demonstration: Australia, Canada, Denmark, Italy, the Netherlands, Norway, Turkey, and the United Kingdom.

GAO Observations

GAO has issued annual reports on the JSF for the last 6 years.¹ The JSF program continues to struggle with cost increases and slow progress—negative outcomes that were foreseeable as events have unfolded over several years. The program continues to be at risk for not delivering aircraft quantities and capabilities on time. Dates for achieving initial operational capabilities may have to be extended and some requirements deferred to future upgrades. In March 2010, the Undersecretary of Defense for Acquisition Technology and Logistics testified that the Marine Corp's initial capability date had not changed and was still planned for 2012, while the Air Force and Navy had both slipped their anticipated initial capability dates to 2016.

¹ For our most recent report, see GAO, *Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time*, GAO-10-382 (Washington, D.C.: Mar. 19, 2010).

The restructuring ordered by DOD leadership in February 2010, included positive steps that should reduce risk and provide more realistic cost and schedule estimates. Officials increased time and funding for system development, added four aircraft to the flight test program, and reduced near-term procurement quantities. If effectively implemented these actions should improve future program outcomes. However, manufacturing test aircraft continues to take more time, money, and effort than budgeted, hampering the development flight test program. While some improvement is noted, continuing manufacturing inefficiencies, parts problems, and engineering technical changes indicate that design and production processes may lack the maturity needed to efficiently produce aircraft at the currently planned rates.

Although restructuring actions should help, there is still substantial overlap of development, test, and production activities while DOD continues to invest in large quantities of production aircraft before the different variants are proved and performance is verified—DOD intends to purchase up to 307 aircraft at an estimated cost of \$58.2 billion before completing development flight testing. At the same time, progress on flight testing is behind schedule—completing only 10 percent of the sorties planned during 2009—because of late deliveries and low productivity. In addition, the program faces other technical challenges including (1) relying on an extensive but largely unproven and unaccredited network of ground test laboratories and simulation models to evaluate system performance; (2) developing and integrating very large and complex software requirements; and (3) maturing several critical technologies essential to meet operational performance and logistical support requirements. Given these challenges, DOD's plan to procure large quantities of JSF aircraft before flight testing proves they will perform as required, increases the likelihood and impact of design, manufacturing, and requirements changes that could result in subsequent cost growth, schedule delays, and performance shortfalls. As the program moves forward, risks are manifold—mounting cost and schedule pressures; complex extensive, and unproven software requirements; and a nascent, very aggressive test program that continues to experience significant delays.

**Appendix III: Summary of Tactical Aircraft
Systems Ongoing and Future Efforts**

Table 3: F-35 Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	2,449.8	2,433.0	1,982.7	1,337.4	446.7	8,649.6
Procurement	9,313.0	9,602.5	12,054.7	12,996.7	14,183.1	58,150.0
Total	11,762.8	12,035.5	14,037.4	14,334.1	14,629.8	66,799.6

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, funds that we have added here.

Figure 6: F-22A Raptor



Source: U.S. Air Force.

Date First Deployed: December 2005

Aircraft Inventory: 157

Average Age of Aircraft: 3 years

System Description

The F-22A is the Air Force's fifth generation air superiority fighter that incorporates a stealthy and highly maneuverable airframe, advanced integrated avionics, and a supercruise engine. It will replace or complement the F-15 as the Air Force's primary air-to-air fighter and was originally developed to counter threats posed by the Soviet Union. However, the Air Force decided to add more robust air-to-ground and intelligence-gathering capabilities not previously envisioned at program start, but now considered necessary to increase the platform's utility in future operations. As a result, the F-22A is now expected to perform multiple missions including air-to-air superiority, destruction of enemy air defenses, air-to-ground attack, electronic attack, and intelligence surveillance and reconnaissance.

Program Status

F-22A demonstration and validation began in October 1986 and system development started in June 1991. Low rate initial production was

approved in August 2001 and full-rate production in March 2005. Initial operational capability was declared in December 2005. The first production aircraft was delivered in June 2003 and, in April 2009, the Office of the Undersecretary of Defense (OSD) announced that F-22A production would end at 187 total aircraft—as of April 2010, the Air Force had received delivery of 157 aircraft. The program is expected to cost a total of \$66.7 billion at completion. The specific cost to shut down the production line has not yet been determined, but according to Air Combat Command (ACC) officials, the shutdown is expected to cost from \$300 to \$700 million.

The Air Force initiated a formal F-22A modernization and reliability improvement program in 2003 to incrementally develop and deliver increasing capabilities over time. As of March 2010, the first increment had been fielded; the second increment was in development flight testing and scheduled to begin follow-on test and evaluation later in 2010; and requirements for the third increment were being analyzed. A fourth increment is being considered, but no formal plans have been made. More than \$3 billion has been obligated to the modernization program through fiscal year 2009, and about \$2.7 billion budgeted for fiscal years 2010 to 2013. The Air Force is continuing efforts to achieve a more common configuration within its F-22A aircraft fleet. Program officials note that this common configuration effort is necessary to maximize the number of aircraft capable of receiving the incremental upgrades.

GAO Observations

At the time of our last tactical aircraft report in 2007, the Air Force continued to believe that 381 F-22A aircraft were required to effectively meet warfighter needs. We noted, however, that because of past cost overruns and budget constraints OSD had limited production quantities to 183, or 198 aircraft fewer than what the Air Force believed were required. Subsequently, the Air Force received approval to procure four additional aircraft. While Air Force officials still believe that procuring 381 F-22A aircraft would provide increased capability to the force and reduce risk, they recognize that no more than 187 will be procured.

The Director of Operational Test and Evaluation (DOT&E) reported that ACC officials acknowledge that the F-22A aircraft will not be able to meet its required reliability rate largely because of difficulties in maintaining its low observable materials and characteristics. According to the program office, the F-22A is not fully capable of performing missions 40 percent of the time, on average. Though a complete assessment of trends will not be available until all test data are collected and analyzed, ACC's interim

findings indicate ongoing challenges in F-22A low observable maintainability. For example, ACC officials noted that the Air Force originally estimated that it would need 36 low observable maintainers for every 40 aircraft, but has since discovered that 106 maintainers are required. DOT&E reported in December 2009, that the Air Force may experience significant challenges in meeting a number of operational suitability thresholds specified in the current F-22 operational requirements and capabilities production documents because of maintainability problems. F-22A program officials emphasize that a low mission capable rate does not mean that the aircraft is not flyable or that it can not perform some missions, but in most cases means that its low observable characteristics have been compromised in some way.

Table 4: F-22 Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	576.3	555.2	467.9	454.0	677.4	2,730.8
Procurement ^a	650.2	506.8	287.9	341.6	255.6	2,042.1
Total	1,226.5	1,062.0	755.8	795.6	933.0	4,772.9

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, sums that we have added here.

^aProcurement funding includes modifications.

Figure 7: A-10 Thunderbolt II



Source: Air Force, Master Sgt. Blake R. Borsic.

Date First Deployed: March 1976

Aircraft Inventory: 356

Average Age of Aircraft: 28 years

System Description

The A-10 was the first Air Force aircraft specially designed for close air support of ground forces. The aircraft remains the premier close air support platform of choice and has maintained a near continuous presence since 2003 in Operations Enduring Freedom and Iraqi Freedom. It has excellent maneuverability at low air speeds and altitude, and is a highly accurate weapons-delivery platform. A wide combat radius and short takeoff and landing capability permit operations in and out of locations near front lines. The A-10 is a simple, effective, and survivable twin-engine jet used against all ground targets, including tanks. In addition, the aircraft can survive direct hits from armor-piercing and high explosive projectiles up to 23 mm. With eleven weapons stations and a targeting pod, the A-10 is able to engage any target with a wide variety of general purpose and precision munitions.

Program Status

Because of the A-10's relevant combat capabilities—demonstrated first during Desert Storm and recently in operations in Iraq and Afghanistan—

the Air Force now plans to keep it in the inventory longer than anticipated. How long and with what upgrades is dependent upon whether the JSF aircraft are delivered on schedule. As we reported in 2007, the Air Force is pursuing several major modifications to upgrade systems and structures on the A-10 fleet. The most costly modification is replacing the wings on two-thirds of the fleet for about \$1 billion. ACC officials said many aircraft are receiving the new wings at 10,000 flight hours, and the officials expect this step to extend service life to 20,000 hours from the current 16,000 hour life.² Wings on the remaining third of the fleet will be repaired as needed. The wing replacement is fully funded through fiscal year 2015.

ACC officials said the number one procurement priority for the A-10 is the Helmet Mounted Cueing System that is intended to reduce the time it takes to identify, engage, and destroy a target by about 400 percent. This system is similar to, but not exactly the same as, the Joint Helmet Mounted Cuing System in use on the F/A-18E/F and being developed for the F-15s; but they only cost about half as much, according to the A-10 officials. The Air Force is also conducting Full Scale Fatigue Testing on the A-10 aircraft and completing its precision engagement modification, a significant upgrade to weapons delivery, avionics, and cockpit controls. A-10A aircraft with precision engagement are redesignated A-10C.

GAO Observations

According to ACC officials, the A-10 was originally envisioned as a single seat, day-only, low-altitude attack aircraft; however, through a number of modernization efforts the aircraft is now a day/night, multi-weapon (both precision guided and general purpose munitions), highly sophisticated aircraft. The Air Force has successfully transformed the A-10 to adapt to the needs of the warfighter, and both the A and C models have much more capability than originally envisioned. The officials noted, however, that software development for the A-10 is critical, especially the software needed to integrate the helmet mounted cuing system with the aircraft.

The A-10 is expected to remain in the Air Force's inventory beyond 2030, although quantities are anticipated to decrease from 340 to 196 by that time through retirements and attrition. While the JSF is slated to meet close air support mission needs, ACC officials question whether the JSF will be as effective as the A-10 in performing that mission. They noted that the JSF will only have a limited gun capability, essential for closing-in on

² The official service life for the A-10 is 16,000 flight hours.

enemy troops without endangering the lives of nearby friendly forces, and may fly too high and too fast for successful close air support. The A-10 on the other hand, can provide support or strike enemy troops to within 20 or 30 meters of friendly forces without endangering them. ACC officials said the Air Force is currently contemplating procurement of a light attack aircraft (designated OA-X) to supplement the A-10, as well as intelligence, surveillance, and reconnaissance missions. However, no official program has been established. And officials are not expecting the effort to result in a complete A-10 replacement, as platforms being considered will not have enough capability to replace the legacy platform.

Table 5: A-10 Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	5.7	5.8	6.0	6.1	6.2	29.8
Procurement ^a	181.9	155.8	148.8	137.8	0	624.3
Total	187.6	161.6	154.8	143.9	6.2	654.1

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, which we have added here.

^aProcurement funding includes modifications.

Figure 8: F-16 Fighting Falcon



Source: www.af.mil.

Date First Deployed: January 1979
Aircraft Inventory: 1,135
Average Age of Aircraft: 20 years

System Description

The F-16 Fighting Falcon is a compact single-engine, multi-role fighter aircraft. It is highly maneuverable and has proven itself in air-to-air combat and air-to-surface attack. It provides a relatively low-cost, high-performance weapon system for the United States and allied nations. The F-16 fleet includes several different configurations or blocks, and comprises more than half of the Air Force's fighter force.

Program Status

The Air Force plans to make a number of improvements to its F-16 fleet, both on the older aircraft, operated primarily by the Air National Guard and the Air Force Reserve Command, and newer aircraft, operated primarily by ACC.³ The aircraft continue to receive structural and engine modifications to enable them to reach an expected 8,000 flight hour

³ Older aircraft are designated blocks 25, 30, and 32; the active component fleet comprises blocks 40, 42, 50, and 52.

service life. Additionally, the older aircraft will receive a new fire control computer because current units lack adequate processing capacity and parts needed to keep them viable are becoming obsolete.

The newer F-16s in the active duty component are receiving a common configuration upgrade that will give them all virtually the same capability. Common systems include the Joint Helmet Mounted Cueing System, a Modular Mission Computer, Link 16 (a communications data link), and color multifunctional displays. Common configuration upgrades were scheduled for completion by June 2010. Additionally, some aircraft are being fitted with ARC-210 Radios to provide secure line-of-sight and beyond line-of-sight satellite communications capability, to replace the fleet's very high frequency FM radios.

GAO Observations

With the JSF facing further delays and a projected shortfall in the Air Force's fighter inventory, the aging F-16 fleet may be required to remain in service longer than currently planned. The Air Force is assessing the viability of different options for sustaining its F-16 fleet to manage this shortfall. These options include (1) procuring new "4.5 generation fighters" with more advanced radar, electronic warfare, and communications capabilities, and (2) extending the service life of up to 300 newer F-16s, along with capability modernizations to provide warfighting capabilities similar to 4.5 generation aircraft. Recently, the Air Force provided Congress with a report titled Procurement of 4.5 Generation Fighter Aircraft, which concluded that modernizing and extending the service life of current fighters would provide essentially the same capability of new 4.5 generation fighters at 10 to 15 percent of the cost. This conclusion was based on a comparison of current estimates for procurement of new 4.5 generation fighters (F-15E+, F-16 block 50+, and F/A-18E/F) and a budget estimate for an F-16 block 40/50 service life extension program (SLEP) to address structural issues and upgrade avionics. Both estimates assumed a procurement quantity of 300 fighters and considered many variables, including making structural improvements only, compared to capability enhancements, and multi-year versus single year procurement.

This estimate precedes a full scale fatigue test and subsequent analysis to be conducted on a block 50 aircraft beginning in 2011 and lasting for about 3 years. However, an Air Force official said that the estimate takes into account known and suspected issues with the aircraft as well as desired modernization options and that fatigue testing would have to uncover a considerable surprise—which he acknowledged is possible—to drive estimates significantly higher. Service officials said the option to extend

the service life of and modernize a number of newer F-16s will be considered as part of the fiscal year 2012 budget process.

The Air Force has also concluded that small investments in older F-16 aircraft will provide relief over the current Future Years Defense Program. Service officials noted that some mission equipment added after these F-16s were built has significantly increased the aircraft's weight and stressed the airframe beyond initial estimates. Investments in these aircraft are therefore aimed at enabling them to reach their anticipated service life, but are not intended to extend the service life of the fleet.

Table 6: F-16 Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 Budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	129.1	110.9	112.6	109.1	110.7	572.4
Procurement ^a	167.2	86.2	25.2	9.6	13.0	301.2
Total	296.3	197.1	137.8	118.7	123.7	873.6

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, sums that we have added here.

^aProcurement funding includes modifications.

Figure 9: F-15C/D Eagle



Source: U.S. Navy, Petty Officer John P. Curtis.

Date First Deployed: 1979
Aircraft Inventory: 379
Average Age of Aircraft: 26 years

System Description

The F-15C/D Eagle is a single- or two-seat, twin engine, all weather tactical fighter designed to permit the Air Force to gain and maintain air supremacy over the battlefield. The Eagle is a fourth generation air superiority fighter that is used for the offensive/defensive counter air missions and homeland defense. The Eagle's air superiority is achieved through a mixture of maneuverability and acceleration, range, weapons, and avionics.

Program Status

F-15C and F-15D aircraft have been in the Air Force inventory since 1979 and are being modernized to enhance operational effectiveness. Air Force officials consider these planned or ongoing upgrades necessary to keep the platform viable:

-
- Operational flight program software upgrades are required to integrate modernization programs onto the F-15, improve combat capability, and provide electronic protection updates for aircraft radars.
 - A new, active electronically scanned array (AESA) radar will provide significantly increased capability over its predecessor and is, according to Air Force officials, the only way to counter the electronic warfare environment into the future.
 - An Infrared Search and Track system, being developed under Navy leadership, will provide passive radar capability to detect and target adversaries without their knowing they are being targeted.
 - New core processor and displays will replace obsolete systems.
 - The Eagle Passive/Active Radar Warning and Survivability System will correct operational deficiencies as well as obsolescence and supportability issues with the aircraft's radar warning receiver that, if not addressed, could force the Air Force to ground F-15s beginning in fiscal year 2015.

In its fiscal year 2010 budget request, the Air Force responded to OSD direction to assume additional risk in its tactical aircraft force structure with a fleet reduction plan—still awaiting congressional approval—that would retire more than 110 F-15s, more than 130 older F-16s, and a small number of A-10s. While Air Force officials said that for sustainment planning they cannot count on the reduction plan being approved, it is needed to free up funding for other priorities, including modernization of legacy forces. Although modernization programs have progressed to a varying extent, many F-15 initiatives remained unfunded or partially funded through the Future Years Defense Program. These programs include the AESA radar, the infrared search and track system, and a number of other projects—some of which have been designated unfunded requirements since at least 2006.

GAO Observations

Long range plans for the fleet call for 176 F-15C/D aircraft equipped with AESA radars and other modernization upgrades to complement the F-22A in performing air superiority missions through 2025. We reported in 2007 that the Air Force will need to modernize and retain more F-15C/D aircraft for longer periods than originally planned because F-22A procurement was to be halted at 187 aircraft instead of the Air Force's stated requirement

for 381.⁴ This continues to be the case, as the 2010 QDR retained the same basic tactical aircraft force structure for the Air Force.

According to ACC officials, while some structural issues need to be addressed on the F-15, the overall airframe is relatively healthy. They noted that at every planned depot maintenance interval, an aircraft is completely examined to identify structural and other problems, and that appropriate solutions are usually found. However, because of the age of the fleet—25 years on average—and the frequency with which the aircraft have been used over the past two decades, the Air Force has launched an extensive investigation into the service life of the F-15, including a detailed, full-scale fatigue test on an F-15C. The intent of this testing, according to recent testimony, is to better understand life-limiting factors for these aircraft, the feasibility of extending their service life, and the economic and operational value of doing so. Contingent on the results of fatigue testing, service officials testified that by enhancing air superiority capabilities through upgrades such as AESA radar, the infrared search and tracking system, and a more capable mission computer, the long-term fleet of 176 F-15C/D aircraft is expected to operate safely and effectively through at least 2025.

Note: Budget information for the F-15C/D is included in this appendix with the discussion of the F-15E (see table 7 below). The Air Force consolidates investment budgets for all models of the F-15.

⁴ GAO, *Tactical Aircraft: DOD Needs a Joint and Integrated Investment Strategy*, GAO-07-415 (Washington D.C.: Apr. 2, 2007).

Figure 10: F-15E Strike Eagle



Source: U.S. Air Force, Staff Sgt. Aaron Allmon.

Date First Deployed: April 1988
Aircraft Inventory: 223
Average Age of Aircraft: 18 years

System Description

The F-15E Strike Eagle is a two-seat dual-role fighter designed to perform air-to-air and air-to-ground missions. An array of avionics and electronics systems gives the F-15E the capability to strike targets at low altitude, day or night, and in all weather. Whereas previous models of the F-15 are assigned air-to-air roles, the "E" model has the capability to fight its way to a target over long ranges, destroy enemy ground positions and fight its way out. The F-15E Strike Eagle retains the basic air-to-air capability of the F-15 A-D Eagle, but adds a weapon systems operator, rear cockpit, and advanced systems for all-weather, day/night, all-altitude, deep penetration air-to-surface attack.

Program Status

The F-15E is the Air Force's only long-range, deep interdiction fighter aircraft, and is expected to be in service until about 2035. The Air Force has a number of modernization programs underway or planned for the F-15E fleet, many of which are also sustainment efforts, as future support

must be taken into account when making major program changes. The principle efforts include:

- AESA radar, to address critical reliability and maintainability issues with the current radar, in addition to providing increased operational capabilities;
- Joint Helmet Mounted Cueing System to provide air crews with “look and shoot” capability to point weapons and sensors based on head position; it will also allow pilots to acquire targets 80 percent faster while simultaneously increasing weapons accuracy and preventing fratricide or collateral damage;
- Satellite communications upgrades, to modify the aircraft’s existing radio configuration and add new radio and antenna hardware in response to urgent operational needs; and
- Eagle Passive and Active Warning and Survivability System that, according to the Air Force, will address current and future electronic warfare threats as well as critical reliability and maintainability issues, significant parts obsolescence, skyrocketing sustainment costs, and aircraft groundings.

GAO Observations

ACC officials noted that they do not expect major program changes to the F-15E as a result of the 2010 QDR because the aircraft is a multimission aircraft and has a sound structural life. The platform is expected to be in service until approximately 2035, and the Air Force does not yet have a planned replacement. With the legacy platform expected to be in the inventory for 25 more years, challenges associated with diminishing manufacturing sources are currently driving high sustainment costs for the aircraft. For example, diminished manufacturing sources increase the risk that aircraft may be grounded as old radars wear out before the new AESA radars can be installed. AESA development is fully funded, while procurement and installation on the fleet is currently planned to occur over 19 years. Once installation of the new radars begins (planned for 2013) the old radars can potentially supply spare parts for other aircraft still awaiting the new radar. Program officials are using the fiscal year 2012 budget process to push for increased annual AESA procurement beyond 24 units annually to avert the risk of groundings. Alternatively, an ACC official said a capability gap will emerge in 2017 unless funding is provided to keep spare parts production lines open for the existing radar. Additionally, although program officials said the new radar development program is going well, test radars are collecting data and information that might require higher security classification than originally planned. If this is the case, there will need to be additional work done to ensure the systems that use the information are certified at the appropriate clearance

levels, a potential development that could delay procurement and installation.

The joint helmet mounted cueing system is thus far only being applied to F-15E front cockpits, with funding provided for 60 percent of the fleet and a limited number of helmets. An ACC official said that the system is important during current conflicts and that the Navy, which is providing system software and components, has had great success with the system. However, funding was initially provided in a supplemental budget for a single year only and is not part of the service's base budget and out-years program. Consequently, the Air Force is trying to identify funding to keep the program going. Similarly, ACC officials told us that radio communications upgrades are only partially funded, and the passive and active warning and survivability system is unfunded.

Table 7: F-15 Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	222.7	212.2	144.3	125.0	118.3	822.5
Procurement	302.2	301.5	390.9	367.8	346.9	1,709.3
Total	524.9	513.7	535.2	492.8	465.2	2,531.8

Source: Fiscal year 2011 President's budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, sums that we have added here.

Figure 11: MQ-9 Reaper Unmanned Aircraft System



Source: U.S. Air Force Photo/Master Sgt. Robert W. Valenca.

Date first deployed: 2007
Aircraft Inventory: 44
Average Age of Aircraft: 3 years

System Description

The Air Force's MQ-9 Reaper is a multirole, medium-to-high-altitude, long-endurance unmanned aerial vehicle system capable of flying at faster speeds and higher altitudes than its smaller predecessor, the MQ-1 Predator. While the Predator is primarily a surveillance and reconnaissance asset, the Reaper is designed for armed reconnaissance missions. It is expected to provide around-the-clock capability to detect, attack, and destroy mobile, high-value, time-sensitive targets. Reaper will carry missiles, laser-guided bombs, and the Joint Direct Attack Munition. Reaper also will support net-centric military operations. Each system consists of four aircraft, a ground control station, and a satellite communications suite.

Program Status

The Reaper program began in January 2002 in the aftermath of the September 11, 2001, terrorist attacks. Since inception, Reaper—designated an urgent operational need—has followed a nontraditional acquisition path, resulting in concurrent development and production and increased risk. Shortly after development began, the user required accelerated aircraft deliveries to achieve an interim combat capability. Two years later, the user required additional aircraft for an even more robust early fielding capability. In response to user demands, the Air Force contracted for over 30 percent of the total quantity before completing initial operational testing. The Reaper completed initial operational testing in August 2008.

Because of recent budget increases, the Reaper program was recently designated a major defense acquisition program. Reaper has been funded under the Predator program element since its inception. In its fiscal year 2008 budget, the Air Force began reporting Reaper as a separate program element, thereby isolating program costs. As of May 2010 the Air Force had a total inventory of 44 Reaper aircraft, of which 23 were designated to support wartime missions. As part of the fiscal year 2011 budget process OSD added \$1.8 billion to the Air Force budget, from fiscal year 2011 through fiscal year 2015, to purchase an additional 74 MQ-9 Reaper aircraft.

GAO Observations

The Air Force completed initial operational testing in August 2008 during which two of the three key capabilities were not fully assessed. The Air Force testers gave Reaper a rating of partially mission capable. DOD's independent test organization has not yet completed its assessment of the test results. In the testing, test personnel determined that the Reaper was effective in destroying targets; however, the platform's radar encountered problems that left the testers unable to assess the Reaper's ability to detect and identify targets. In addition, testers did not assess the Reaper's net centric operations capability. Other areas of concern included operator workload, off-board communications, and system reliability. Because the tests were limited, further testing will be needed.

Although the Reaper is capable of performing strike missions, it is not viewed as a replacement for manned fighter and attack aircraft. Instead, OSD and Air Force officials emphasize that the Reaper, like other unmanned aircraft systems, provides complementary or supplemental capabilities that allow manned fighter and attack aircraft to more effectively and efficiently perform their missions. They note that the Reaper was not designed with stealth or self-protection capabilities and is therefore not capable of performing missions in defended airspace. They

also point out that replacing manned aircraft with Reapers would require guaranteed, uninterrupted communication with Reaper aircraft to ensure mission success and the safety of friendly troops, and that guarantee is not yet possible.

In 2010 DOD made a commitment to grow to a sustained capacity of 50 Reaper/Predator orbits—each orbit, if fully equipped, would be made up of 4 aircraft and associated ground control equipment. However, the 2010 Quadrennial Defense Review and OSD's Aircraft Investment Plan noted an expanded need for both manned and unmanned intelligence, surveillance, and reconnaissance aircraft and directed the Air Force to increase the number of Reaper orbits from 50 to 65 by 2013. Reaper program officials told us that while they expect to achieve 65 orbits on time, orbits will not be fully equipped.

In the fiscal year 2011 budget process, OSD added \$344 million to the Air Force budgets for the period fiscal year 2011 through 2015 to develop, procure, and integrate counter-communication and counter-improvised explosive device jamming pods onto 33 MQ-9 Reaper aircraft, and directed the Air Force to present its assessment of platforms for this capability by June 1, 2010. According to Reaper program officials the funds provided are contained in an OSD-level electronic warfare budget line and were not added to the Reaper program budget. They also pointed out that although the OSD direction singled out the Reaper, the Air Force is currently doing an analysis to determine which platform would best meet its needs. Air Force officials emphasize that those pods would not be operational until the Block 5 Reapers are delivered—beginning in fiscal year 2013—because they need the additional power that the Block 5 is expected to provide.

Table 8: MQ-9 Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	125.4	111.6	80.2	52.9	27.4	397.5
Procurement	1,079.6	1,092.2	1,142.1	1,042.2	1,053.0	5,409.1
Total	1,205.0	1,203.8	1,222.3	1,095.1	1,080.4	5,806.6

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, amounts that we have added here.

Figure 12: F/A-18E/F Super Hornet



Source: www.navy.mil.

Date First Deployed: 2002
Aircraft Inventory: 393
Average Age of Aircraft: 5 years

System Description

The F/A-18E/F Super Hornets are single-seat and two-seat high performance, twin-engine, mid-wing, multimission tactical aircraft designed to meet current Navy fighter escort and interdiction mission requirements, to maintain F/A-18 fleet air defense and close air support roles, as well as an increasing range of missions. The program was approved as a major modification in the F-18 series in May 1992. It is replacing the F/A-18A/B/C/D and has an improved range and payload and is less detectable.

Program Status

The Navy began procuring the F/A-18E/F in 1996, and it is the Navy's only remaining carrier-based strike-fighter. In the future the F/A-18E/F and the F-35 will form the core of each Navy carrier air wing. Of the aircraft projected to be in each carrier air wing, 44 will be strike fighters, such as the F/A-18E/F and F-35.

Although many of the F/A-18E/F aircraft have been in the fleet for less than a decade, a Service Life Assessment Program for the Super Hornet was started in 2008 and is assessing the feasibility of extending the 6,000 flight hour service life to 9,000 hours or greater. This is the first step to determine how long the planes will last and what significant repairs may be needed to extend the planes beyond their initial minimum life span of 6,000 flight hours.

If there are any delays in reaching full operation capability for the F-35, which is intended to be a replacement aircraft for the Navy, these delays will require the Navy carriers and expeditionary Marine squadrons to continue to be equipped with the F/A-18 aircraft not previously expected to serve in that capacity for that length of time. Any delays in a replacement aircraft must be absorbed wholly within the F/A-18 community. Also, support for these aircraft must be extended, including training for aircrew and maintainers, spare aircraft parts, and repair facilities. Brief delays have been mitigated by reducing flying, reducing squadrons, and reducing aircraft allocations. Longer delays will require the Navy to revise acquisition and sustainment plans. With each official F-35 schedule delay, these plans are invalidated and must be revised. According to Navy inventory predictions, the F/A-18E/F fleet will start retirement in 2014 and will be completely retired by the end of 2032.

GAO Observations

DOT&E has noted that, there are significant deficiencies with improvements to the F/A-18E/F program. According to a DOT&E official, the F/A-18E/F program has undergone recent testing to assess the AESA radar, which is a new and improved radar capability. DOT&E has identified problems with

- radar performance,
- suitability issues,
- inability to meet reliability requirements, and
- deferral of the radar's electronic warfare capabilities

Despite these deficiencies the Navy has elected to deploy the F/A-18E/F because of the improved capability the AESA radar offers over the old radar. DOT&E also expressed concerns about the progress made in developing and characterizing the full electronic warfare capabilities of the AESA radar.

Additionally, uncertainty of the F-35 program makes planning for the F/A-18E/F difficult. If additional F/A-18E/F aircraft are needed, the decision to

buy these aircraft must be made soon. In 2007, we noted that one option available to the Navy was simply to buy more new F/A-18E/F aircraft. The F/A-18E/F production line is still running, and this option remains viable. However, the Navy does not appear to include it in any of its analyses. During a congressional hearing in April 2010, senior Navy officials did not provide a direct answer when they were asked if they had compared the cost of buying new F/A-18E/F with the estimated cost of extending the service lives of legacy aircraft. Our analysis, using the Navy's most recent estimates and data from the December 2009 Selected Acquisition Reports, indicates that buying additional aircraft has the potential to provide a better return on investment as measured by the cost per marginal flight hour. In May 2010 the Navy decided to proceed with a multi-year procurement contract for 124 F/A-18E/F and EA-18G aircraft in Fiscal Years 2010 through 2013. The Navy estimates it will save approximately \$590 million.

Table 9: F/A-18E/F Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E ^a						
Procurement ^b	1,828.4	539.1	2,283.9	205.6	16.2	4,873.2
Total	1,828.4	539.1	2,283.9	205.6	16.2	4,873.2

Source: Fiscal year 2011 President's Budget

Note: The President's budget requested supplemental funds in associated accounts where appropriate, amounts that we have added here.

^aSee F/A-18 A/B/C/D Appendix for RDT&E funding for F/A-18 Squadrons.

^bProcurement funding includes modifications.

Figure 13: F/A-18A-D Hornet



Source: www.navy.mil.

Date First Deployed: November 1978
Aircraft Inventory: 635
Average Age of Aircraft: 24 years (A), 25 years (B), 18 years (C), 17 years (D)

System Description

The F/A-18A/B/C/D is an all-weather fighter and attack aircraft also known as the Hornet. It is a single- and two-seat, twin-engine, multimission fighter/attack aircraft that can operate from either aircraft carriers or land bases. The FA-18 fills a variety of roles: air superiority, fighter escort, suppression of enemy air defenses, reconnaissance, forward air control, close and deep air support, and day and night strike missions.

Program Status

In November 2007, Navy officials initiated plans designed to better manage the use of Hornet service life. Under this program, service life was managed for each individual aircraft enabling a more comprehensive and efficient approach to aircraft service life preservation. In addition, a Service Life Assessment Program determined the level of investment that would be required to extend service life to 10,000 hours. Earlier phases of this program extended the catapult and landing limits on the fleet. Retirement of aging Hornets has begun and goes through 2023, as the aircraft are replaced by F/A-18 E/F Super Hornets and eventually the carrier variant of the F-35 Joint Strike Fighter.

Although the F/A-18 A/B/C/Ds are out of production, the existing inventory of 638 Navy and Marine Corps aircraft will continue to comprise half of the Naval Aviation force structure through 2013, and are scheduled to remain in the inventory until 2023. The Navy is in the process of conducting High Flight Hour inspections to identify and correct problems on aircraft as they reach 8,000 hours. As a result, the aircraft are expected to gain an additional 600 hours of service life. In addition, the Navy is considering a more significant SLEP for 280 Hornets to get the aircraft to 10,000 hours and help mitigate projected inventory shortfalls. This SLEP would modify or replace primary aircraft structures that have reached fatigue life limits, as well as address parts obsolescence issues and provide some additional capability. The Navy estimates that the program will cost an average of \$25 million per aircraft, a total of about \$7 billion for 280 aircraft.

GAO Observations

Procurement of Super Hornets has proceeded fairly close to schedule, but the JSF continues to experience cost increases and schedule delays. Uncertainty in the JSF program makes planning for the F/A-18A/B/C/D difficult. OSD recently restructured the program to add more time and money. As a result, the Navy moved its full rate production date out another 2 years, into 2016. To maintain force structure requirements for carrier-based strike fighters, delays in delivering operational JSF aircraft will have to be absorbed by the F/A-18 family. This means that aging Hornets may need to be retained longer than expected in inventory, along with additional support costs, including training for aircrew and maintainers, spare parts, increased maintenance, and repair facilities. Although force structure shortfalls caused by brief delays in replacement aircraft have been mitigated through “work around” strategies (e.g., decreased flying hours and reduced squadrons and aircraft allocations), longer delays or reduced quantities may require revised acquisition and sustainment plans with attendant funding. With each official JSF schedule delay, these plans may be invalidated and need to be revised.

Table 10: F/A-18 A/B/C/D Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E ^a	148.4	115.4	71.9	61.9	38.3	435.9
Procurement ^b	536.1	470.9	446.6	598.1	559.1	2,610.8
Total	684.5	586.3	518.5	660.0	597.4	3,046.7

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, amounts that we have added here.

^aRDT&E funding is for F/A-18 Squadrons.

^bProcurement funding includes modifications.

Figure 14: EA-18G Growler



Source: www.navy.mil.

Date First Deployed: Anticipated in 2010
Aircraft Inventory: 22
Average Age of Aircraft: 1 year

System Description

The EA-18G Growler will replace the EA-6B Prowler as DOD's tactical electronic attack aircraft. Like the Prowler, the EA-18G will provide full-spectrum electronic attack to counter enemy air defenses and communication networks. The Growler is the 4th variant in the F/A-18 family and has a high degree of commonality with the F/A-18F, retaining the latter's inherent strike-fighter and self-protection capabilities while adding electronic warfare capabilities to protect U.S. strike forces. The EA-18G incorporates advanced jamming capabilities avionics for the suppression of enemy air defenses, including accurate emitter targeting for employment of onboard weapons such as the High-Speed Anti-Radiation Missile.

Program Status

In 2002, an analysis of alternatives was completed which identified 27 platform combinations that were capable of delivering jamming support. As a result the Navy opted to develop the EA-18G to replace the EA-6B. The study was motivated by a projected shortfall of the EA-6B inventory,

primarily caused by attrition and the increasing cost of operating the aging fleet. The Navy's original plan was to procure a total of 88 EA-18G aircraft. However, in 2009 OSD directed the Navy to buy an additional 26 aircraft in fiscal years 2011 and 2012 bringing the total aircraft inventory to 114. The Navy originally estimated the average procurement unit cost of the program to be around \$67 million (base year 2004 dollars), and as of December 2009 the average unit cost had increased \$6 million or 9 percent, to \$73 million (base year 2004 dollars). As of October 2009, Navy officials noted that 14 Growlers had been delivered, and emphasized that those deliveries were more than 2 months ahead of contract requirements. First deployment of the EA-18G is anticipated in 2010.

The Director of Operational Test and Evaluation conducted testing on the EA-18G and found the aircraft to be operationally effective, but not operationally suitable based upon poor maintainability, Built-In-Test performance, and problems with the legacy ALQ-99 jamming pods. Testers reported that the Navy is proceeding aggressively to resolve deficiencies. Testers recommended that the Navy should consider accelerating development of the next generation jammer to address the problems with the ALQ-99 jamming pods. Live fire tests showed that the Growler is survivable in its planned operational environment, but with some limitations because of the lack of a dedicated radar warning capability.

GAO Observations

Recapitalizing the EA-6B fleet with EA-18G aircraft was originally intended to ensure that the Navy had sufficient electronic attack aircraft to support its carrier strike groups. The Navy and Air Force had agreed that the joint expeditionary mission—performed by both services using EA-6B aircraft—would transition to the Air Force in 2012 as the Navy retired its EA-6B fleet. However, according to an Air Force official, on at least two occasions the Air Force abandoned its efforts to develop a stand-off jamming capability for the B-52 bomber, and did not pursue any other program to perform the expeditionary mission. As a result, OSD directed the Navy to procure an additional 26 EA-18Gs in 2011 and 2012 to meet a perceived shortfall in aircraft performing the expeditionary escort mission and delayed the procurement of 25 F/A-18E/F aircraft to 2013. Even with the increased quantities, the Growler will still be considered a low density, high-demand asset. Although no official decision has been made, the Navy's future inventory projections assume that the JSF will eventually recapitalize the EA-18G fleet. According to Navy data, the Growler fleet will start retirement in 2027 and be completely retired by the end of 2032.

**Appendix III: Summary of Tactical Aircraft
Systems Ongoing and Future Efforts**

Table 11: EA-18G Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	22.0	16.8	17.0	17.7	18.5	92.0
Procurement	1,095.1	2,361.1	115.3	67.5	11.8	3,650.8
Total	1,117.1	2,377.9	132.3	85.2	30.3	3,742.8

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, amounts that we have added here.

Figure 15: EA-6B Prowler



Source: Airborne Electronic Attack Systems and EA-6B Program Office.

Date first deployed: May 1968
Aircraft Inventory: 94 aircraft
Average Age of Aircraft: 26 years

System Description

The EA-6B Prowler has served as DOD's primary Airborne Electronic Attack platform for many years. The primary mission of the Prowler is the suppression of enemy air defenses in support of strike aircraft and ground troops by interrupting enemy electronic activity and obtaining tactical electronic intelligence within the combat area. The EA-6B uses the ALQ-99 radar jamming pod for non-lethal protection by jamming air defense systems and its AGM-88 High Speed Anti-radiation missile for lethal physical attack of air defense systems. Both the Navy⁵ and the Marine Corps currently maintain Prowler assets.

⁵ The Navy and Air Force under a memorandum of understanding jointly operate four expeditionary squadrons of EA-6B aircraft.

Program Status

The Navy began replacing its EA-6B aircraft with the EA-18G Growlers in 2009 and expects all Prowlers to be out of its inventory by 2012. The Navy is transferring 32 Prowlers to the Marine Corps and will retire the remaining fleet. The Marine Corps plans to replace all of its Prowlers with JSF aircraft by 2019. In September 2009, OSD directed the Navy to suspend retirement of the EA-6B as a result of combatant commander's urgent request for joint expeditionary airborne electronic attack capability. Subsequently, OSD directed the Navy to acquire 26 additional EA-18G aircraft, to meet the joint expeditionary need.

Over the last several years, the Navy has made significant upgrades to the EA-6B. Those upgrades include:

- the Improved Capability electronic suite modification (ICAP III) which provides the EA-6B with greater jamming capability;⁶
- an upgrade to the aircraft's current electronic pods, which improves frequency band capability; and
- replacement of the wing center sections of the entire fleet and outer wing panel replacement on portions of the fleet.

ICAP III improvements are being done in a series of block or incremental modifications specifically designed to improve the aircraft's overall capability as both a radar jamming and High Speed Anti Radiation platform. Initial operational testing of the ICAP III validated the improvements of ICAP III over ICAP II. The program has continued to demonstrate its effectiveness during testing. However, there have been problems related to the platform's ability to conduct low band transmitter testing and mission planning for the later ICAP III blocks. The Director of Operational Test and Evaluation wants the program to conduct a total system evaluation in mission scenarios and to address the issues related to low band transmitter testing.

GAO Observations

Recapitalizing the EA-6B fleet with EA-18G aircraft was originally intended to ensure that the Navy had electronic attack aircraft to support its carrier strike groups. The Navy and Air Force had agreed that the joint expeditionary mission—performed by both services using EA-6B aircraft—would transition to the Air Force in 2012 as the Navy retired its EA-6B fleet. However, according to an Air Force official, on at least two

⁶ The most recent jamming improvement program ICAP III includes the ability to perform selective reactive jamming.

occasions the Air Force abandoned its efforts to develop a stand-off jamming capability for the B-52 bomber, and did not pursue any other program to perform the expeditionary mission. As a result, OSD directed the Navy to procure an additional 26 EA-18Gs from 2011 to 2012 to meet a perceived shortfall in aircraft performing the expeditionary escort mission and delayed the procurement of 25 F/A-18E/F aircraft to 2013.

According to program officials, parts obsolescence presents the biggest challenge to the EA-6Bs ability to fulfill its role. While the Navy has made several structural upgrades to its EA-6B fleet, program officials note that as the aircraft stays in service longer, other unforeseen issues will begin to emerge. As a result, there are a number of items associated with the airframe, components, and avionics that the officials are watching closely. The items being watched include the cockpit floors, side walls, fin pods, bulkheads, actuators, engine components, landing gear, and avionics software.

The Marine Corps plans to operate EA-6B ICAP III aircraft through 2019 and then recapitalize its entire fleet with JSF aircraft. The Marine Corps expects the JSF will have some inherent electronic warfare capabilities. However, delays in delivery of the JSF or changes in quantity could require the Marine Corps to keep its EA-6Bs in service longer than planned.

Table 12: EA-6B Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E ^a	24.3	22.4	22.8	23.5	24.2	117.2
Procurement ^b	29.9	15.2	11.6	5.0	0	61.7
Total	54.2	37.6	34.4	28.5	24.2	178.9

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, which we have added here.

^aRDT&E funding is limited to Electronic Warfare counter response.

^bProcurement funding includes modifications.

Figure 16: AV-8B Harrier



Source: Ted Carlson.

Date first deployed: January 1985
Aircraft Inventory: 146
Average Age of Aircraft: 14 years

System Description

The AV-8B Harrier is a short field take-off and vertical landing jet aircraft that deploys from naval ships, advanced bases, and expeditionary airfields. Its mission is to attack and destroy enemy surface targets and escort friendly aircraft, day or night, under all weather conditions during expeditionary, joint, or combined operations. The Harrier is responsible for conducting close air support; armed reconnaissance and air interdiction; offensives and defensive anti-air warfare, including combat air patrol; armed escort mission; and offensive missions against enemy ground-to-air defenses.

Program Status

The Marine Corps introduced the AV-8B, a more powerful longer range variant of the AV-8A, beginning in 1985. The original AV-8B aircraft were only capable of performing daytime missions, but in 1991 and 1992 the Marine Corps upgraded the AV-8B to provide nighttime capability. There is only one day-only aircraft left in the Marine Corps inventory. Between

1994 and 2001, the Marine Corps remanufactured the majority of AV-8B's with new fuselages to increase airframe life and installed a new radar for better weapons delivery. The Marine Corps currently has 146 AV-8Bs, which it plans to replace entirely with JSF aircraft by 2021.

In 2007, we reported that the AV-8B was originally designed to last 6,000 flying hours. This was based on a 20-year service life engineering estimate that projected the aircraft would be flown 300 hours per year on rigorous missions. At that time, the Marine Corps was confident that it could exceed the 6,000 hour estimate. However, in 2009 the program office transitioned from using flight hours to track service life to using a metric that combines flight hours with aircraft fatigue to determine a percentage of fatigue life expended. According to program officials the AV-8B fleet will not begin to reach its service life limits until around 2027, with no significant impact until 2040. Program officials, however, indicated that they had concerns regarding attrition and obsolescence affecting the platform's use for the near term.

GAO Observations

The most recent schedule delays and problems related to the JSF are likely to cause the Marine Corps to operate the AV-8B longer than originally planned. In 2007, we reported that the Marine Corps was planning to begin replacing its AV-8Bs with JSFs in 2011, but according to a program office briefing from November 2009, the Marine Corps now does not expect to begin replacing the aircraft until 4 years later in 2015. Program officials emphasize that funding for AV-8B sustainment is directly impacted by changes to the replacement schedule. Therefore, as the JSF slips, the Marine Corps will have to identify additional funding for the AV-8B or simply retire the aircraft and accept a gap in capability. Program officials told us that their goal is to keep sufficient numbers of aircraft capable and available until the JSF enters the inventory. As such, their key concern is to obtain the needed funds to address their problems through either program-related logistics or program-related engineering.

Program officials note that fatigue life is not the biggest threat to the AV-8B fleet—the aircraft will not begin to reach their fatigue life limits until 2027; instead, aircraft attrition and parts obsolescence are the major risks. According to program officials, the Harrier operating and support costs have risen, and the attrition rate is about two aircraft per year. When the AV-8B program began, the Marine Corps did not expect to operate them for more than 6,000 flight hours, so it did not plan ahead for possible parts obsolescence issues. As a result, no significant effort was made to work with the industrial base to ensure they would have spares and other

necessary parts beyond the 6,000-flight-hour mark. However, the aircraft are now being required to fly beyond the initial flight hour limit and as a result are facing the issue of vanishing parts vendors and parts obsolescence. Specifically, problems program officials noted with diminishing manufacturing sources include the fact that many of the smaller vendors and suppliers that made engine and other parts when the program began have since gone out of business, making it difficult and expensive for the Marine Corps to replace some of those parts as they wear out.

Table 13: AV-8B Fiscal Year 2011 Defense Budget Request

Dollars in millions						
FY2011 budget	FY11	FY12	FY13	FY14	FY15	Total
RDT&E	22.9	21.4	14.5	13.4	13.8	86.0
Procurement	91.5	18.4	24.3	21.4	11.0	166.6
Total	114.4	39.8	38.8	34.8	24.8	252.6

Source: Fiscal year 2011 President's Budget.

Note: The President's budget requested supplemental funds in associated accounts where appropriate, which we have added here.

Appendix IV: Comments from the Department Of Defense



OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

JUL 27 2010

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

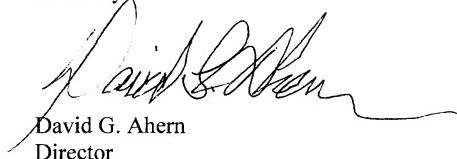
Dear Mr. Sullivan:

This is the Department of Defense (DoD) response to the GAO draft report, GAO-10-789, "TACTICAL AIRCRAFT: DoD's Ability to Meet Future Requirements Is Uncertain with Key Analyses Needed to Inform Upcoming Investment Decisions," dated June 16, 2010 (GAO Code 120852). Detailed comments on the report recommendations are enclosed. Technical comments have been provided under separate cover.

The DoD partially concurs with recommendations one, three and four and concurs with recommendation two. The rationale for our position is included in the enclosure.

We appreciate the opportunity to comment on the draft report. My point of contact for this effort is Ms. Danielle Buckon, Danielle.Buckon@osd.mil, 703-697-2640.

Sincerely,



David G. Ahern
Director
Portfolio Systems Acquisition

Enclosure:
As stated

**GAO DRAFT REPORT DATED JUNE 16, 2010
GAO-10-789 (GAO CODE 120852)**

**“TACTICAL AIRCRAFT: DOD’S ABILITY TO MEET FUTURE
REQUIREMENTS IS UNCERTAIN WITH KEY ANALYSES NEEDED TO
INFORM UPCOMING INVESTMENT DECISIONS”**

**DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS**

RECOMMENDATION 1: To address the uncertainty surrounding projected tactical aircraft shortfalls, we recommend that the Secretary of Defense, working with the Secretaries of the Air Force and the Navy, more clearly explain the department’s requirements and the size and severity of anticipated tactical aircraft shortfalls, identify the key assumptions underlying shortfall projections, and identify alternatives and associated costs to mitigate the impact.

DoD RESPONSE: Partially concurs. The Departments of the Navy and Air Force have provided this type of information to Congress in support of the FY 2011 President’s Budget. However, as indicated to Congress, the assessment of requirements and inventory trends changes over time as DoD assesses the evolving strategic environment and associated asset impacts. DoD’s latest analysis will be reflected in the 2012 President’s Budget.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense more directly and clearly articulate how the complementary capabilities provided by unmanned aircraft, bombers, missiles, and other weapon systems are accounted for and quantified when calculating tactical aircraft requirements.

DoD RESPONSE: Concurs. DoD is conducting multiple analyses and studies examining the Department’s aviation portfolio with the intent of achieving the correct balance of capabilities and capacity. These studies will inform the Department’s FY 2012 President’s Budget.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense complete a comprehensive tactical aircraft analysis that compares and contrasts the costs and benefits of extending the lives of legacy aircraft with the costs and benefits of procuring additional new aircraft. This analysis should be provided to the Congress with the defense budget in February 2011.

DoD RESPONSE: Partially concurs. OSD and the Services are assessing TACAIR costs and capabilities in preparation for the FY 2012 President's Budget. The focus is on platforms and systems that require a near term decision. DoD will provide the results and the supporting rationale in written statements and testimony.

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense direct that future editions of the Aircraft Investment Plan include not only acquisition costs for new systems, but also investments for modernizing and sustaining legacy aircraft, including service life extension programs.

DoD RESPONSE: Partially concurs. The Aircraft Investment Plan, as directed by Congress, addresses aircraft procurement and modernization. Should Congress require additional data, DoD would recommend a change in the reporting parameters.

Related GAO Products

Quadrennial Defense Review: 2010 Report Addressed Many but Not All Required Items. [GAO-10-575R](#). Washington, D.C.: April 30, 2010.

Defense Acquisitions: Assessments of Selected Weapon Programs. [GAO-10-388SP](#). Washington, D.C.: March 30, 2010.

Joint Strike Fighter: Significant Challenges and Decisions Ahead. [GAO-10-478T](#). Washington, D.C.: March 24, 2010.

Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time. [GAO-10-382](#). Washington, D.C.: March 19, 2010.

Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program. [GAO-10-520T](#). Washington, D.C.: Mar. 11, 2010.

Unmanned Aircraft Systems: Additional Actions Needed to Improve Management and Integration of DOD Efforts to Support Warfighter Needs. [GAO-09-175](#). Washington, D.C.: November 14, 2008.

Homeland Defense: Actions Needed to Improve Management of Air Sovereignty Alert Operations to Protect U.S. Airspace. [GAO-09-184](#). Washington, D.C.: Jan. 27, 2009.

Defense Acquisitions: Opportunities Exist to Achieve Greater Commonality and Efficiencies among Unmanned Aircraft Systems. [GAO-09-520](#). Washington, D.C.: July 30, 2009.

Tactical Aircraft: DOD Needs a Joint and Integrated Investment Strategy. [GAO-07-415](#). Washington, D.C.: April 2, 2007.

Future Years Defense Program: Actions Needed to Improve Transparency of DOD's Projected Resource Needs. [GAO-04-514](#). Washington, D.C.: May 7, 2004.

Tactical Aircraft: Modernization Plans Will Not Reduce Average Age of Aircraft. [GAO-01-163](#). Washington, D.C.: February 9, 2001.

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